BOOKS just published, printed for J. HODGES *at the* Looking-Glass, *over-against* St. Magnus Church, *London-Bridge.*

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The Compendious

ASTRONOMER:

CONTAINING

NEW and CORRECT TABLES

For Computing in a concise Manner,

The Places of the LUMINARIES;

Digested from

N U M B E R S

Founded on

The latest Observations;

All the TABLES hitherto published making the Apogé of the Sun about Seven Minutes too far.

The TABLES of the MOON are disposed according to Sir *Isaac Newton*'s Theory, from whence each Equation may be taken out with the same Ease as that of the Sun's Centre, and consequently her Place be obtain'd in a Tenth Part of the Time of any other Method extant; with Remarks whereby the said Theory is made to correspond with Observations.

The Young Arithmetician's and Historian's Perpetual and Universal POCKET-CHRONOLOGER, curiously engraven on a Copper-Plate, by which and a very easy Arithmetical Calculus, may be determined, on the aforesaid Principles, the Place of each Luminary to the like Exactness, as by the Tables, with the Solutions of various Problems both useful and necessary in Chronology, &c.

To render this Treatise independant of any other,

There is likewise introduced,

The *Theory* of DECIMAL ARITHMETIC, Both Terminate and Circulate;

Together with their Demonstrations, which by the late ingenious Mr. *Cunn*, and other Authors, are omitted.

By *CHARLES BRENT*.

LONDON,

Printed for JAMES HODGES, at the *Looking-Glass* over-against *St. Magnus Church*, *London-Bridge*. MDCCXLI.

TO

William Jones, Esq;

Fellow *of the* Royal-Society.

SIR,

WHEN a Treatiſe of this kind makes its Appearance in the World, it naturally ſeeks the Sanction of one, who is excellently ſkill'd in the Science it treats of; for which you are not only eminently diſtinguiſh'd, but likewiſe, for Encouraging all Productions that may be of Uſe and Service.

Theſe, among many other valuable Qualities, which you poſſeſs, toge-

ther with the Belief, that this Treatise will not be unacceptable to the Public, has embolden'd me to address it to you.

I am not insensible (with the great Mr. *Lock)* that I here make you such a Present, as the poor Peasant to his rich and wealthy Neighbour, by whom the Basket of Flowers was not ill received, tho' he had more Plenty of his own Growth, and in much greater Perfection.

I am, SIR,

Your most humble Servant,

CHARLES BRENT.

THE

PREFACE.

IT may not be altogether unnecessary to set forth what gave rise to this Treatise, as also the Methods by which the Tables contained herein were constructed.

And, first, observing that in order to reconcile History with Chronology, &c. *there wanted some Expedient, whereby from certain Data, the Times and Seasons of memorable Transactions and Phænomena might with Ease and Certainty be pointed out: This put me upon devising the* Chronologer; *but with no farther View, at first, than that of my own private Use; the contriving of which from time to time, furnished me with Methods by which the Tables were constructed; and which again in return were reciprocally conducive to the modulating and digesting the* Chronologer *into the Order it now stands.*

The Manner of constructing the Tables of the Sun, is obvious from what is laid down

in p. 101, &c. *And the Reason why its Mean Places, as well as those of the Moon, are tabulated to every Day at Noon in the Radical Year* 1736, *instead of the Mean Motions as usual, is (beside other Advantages) that Tables of the Mean Motions of the Sun from the Moon, as also the Calculations deduced from thence for finding the Mean Time of Eclipses, are thereby fully supplied.* See p. 292, &c.

The Mean Motion of the Sun to Thirds, for a Year of 365 *Days, according to the latest and most accurate Observations, is found to be* $11^s\ 29^\circ\ 45'\ 40''\ 17'''$. *The Radical Year* 1736 *is Leap-Year, which therefore, consists of* 366 *Days; the Mean Place of the Sun on the last Day of the said Year by the Tables is* $9^s\ 20^\circ\ 59'\ 56''\ 11'''$, *from which if there be taken* $9^s\ 21^\circ\ 14'\ 15''\ 54'''$, *the Mean Place on the first Day of the said Year, the Difference* $11^s\ 29^\circ\ 45'\ 40''\ 17'''$ *will be the Mean Motion for* 365 *Days, and is as above, which proves the Correctness of the Tables; in like manner may the Correctness of the other Tables be proved.*

The Tables of the Sun, at first were designed to Seconds of a Degree only, see *Examples* p. 109. 113. 117. *but are since computed to Thirds; in which, and in the Example* p. 121. *the Motion of the* † *Apoge was omitted, but is since added in the Mean Places for every Day throughout the Radical Year; therefore I refer you to the same Example,* p. 164.

† 10 Thirds *fere* each Day.

The

The Tables of the First or Annual Equations of the Moon, Apogé, and Node, were constructed, as directed by Sir Isaac Newton.

The Second Equation of the Moon, when her Apogé is in the Octant of the Sun, and the Sun at the same time in his Apogé, Sir Isaac *makes to be* 3′. 34″; *but if the Sun should be then in his Perigé, it is to be increased by* 22″; *in all other Situations the said* 22″ *is to be proportioned as the Differences of the Cubes of the Distances of the Sun from the Earth, which must then be added to the aforesaid* 3′. 34″; *but if the Moon's Apoge be not at the same time in the Octant of the Sun, the same is to be reduced thus; as the Radius, is to the Sine of the double Distance of the Moon's Apogé from the Sun, so will the aforesaid Equation (which would have taken Place, if the Moon's Apogé had been in the Octant of* ☉) *be to the present Equation out of the Octant.*

The Third Equation is 47″, *when the Moon's Node is in the Octant of the Sun; but, when not therein, it must be proportioned as the former, with the double Distance of the Node from the Sun.*

The like is to be observed with the respective Numbers and double Distance of the Sun from the Moon in the Variation, in which Sir Isaac *makes the greatest Increment, the Sun being in his Perige, to be* 4′ *or* 240″, see

ſee *the* Chronologer, *where the ſaid Increment is, by Sir* Iſaac's *aforeſaid Rule, computed to every* 6° *of Anomaly, which, as may be eaſily ſeen, is ſufficiently exact. For the Uſe thereof,* ſee p. 320. 328.

The Fourth and Seventh Equations are proportioned alſo as the former, with their reſpective ſingle Diſtances, &c. ſee p. 127. 136.

The Fourth Equation, ſo uſed by ſome, Sir Iſaac *makes the Second Equation of the Moon's* * *Centre, and therefore to be applied after the Elliptic Equation, in which Caſe the Numbers to enter the Table for taking out the ſaid Equation, may be* 12° 18′ 40″ *odds,* viz. *the greateſt Second Equation of the Moon's Apogé, the which will create a Difference of about* 30″ *in the Place of the Moon; but if the ſame be applied after the Variation, in that reſpect the Difference will be inconſiderable, when it will become the Sixth Equation, agreeable to Sir* Iſaac's *Theory, which Method is (as it muſt always be according to the Theory) purſued in re-computing the Moon's Place by the* Chronologer *for* Dec. 12, &c. 1738. ſee p. 143, &c.

The Principles for obtaining the Second, Third, and Variation Equations, in or out of the Octants, being the ſame; if Unity, with ſo many Cyphers as convenient, be compared with each reſpective Equation in the Octant, and the ſame reduced to each Degree of the ſaid Octant, according to the ſaid

* Prin. p. 302. Engliſh Edit. Vol. II.

ſaid Principles (which Calculi will be found vaſtly eaſy by Logarithms) you will thereby have a Table of Decimal Multiplicators ſerving to the ſaid Equations; and tho' obtain'd by the double Diſtance, will be beſt to ſet againſt the Single of each Degree of the Octant; by which means the ſingle Diſtance in entering the ſaid Table at any time, may be made uſe of inſtead of the Double.

In the Chronologer, *the ſaid Multiplicators are only to every other Degree of the Octant, under the Title, Second, Third, Var. Sixth, and Seventh Equations.*

Next, entering this Table with the proper Diſtance, and taking out the correſponding Multiplicator, by which multiplying the reſpective Equation, as would have taken place in the Octant, gives the preſent Equation required.

Applying half of the reſpective Diſtances, uſed in the Sixth and Seventh Equations, to this Table of Multiplicators, the ſame will be made to ſerve for them alſo; as is plain, each Multiplicator anſwering to Double the Diſtance entered with. See p. 127. 136.

Having, by the aforeſaid Method, calculated the Table of Decimal Multiplicators, all the reſpective Tables, with their proper Numbers were computed thereby, as alſo the Increments to the Second and Variation Equations, viz. *ſuppoſing the greateſt Increment to take place.*

*And here it is to be observed, that the Increment in the Tables, answering to any Distance entered with, is the greatest reduced to correspond with the said Distance; but when any other Increment than the greatest takes place, as found by the Sun's Mean * Anomaly, the aforesaid Increment, taken out of the Table, will require a Reduction,* viz. *As the greatest Increment, is to that answering the present * Anomaly, so is the Increment in the Table, corresponding to the Distance enter'd with, to the present Increment required.*

Wherefore the Ratios between the greatest Increment, and those answering to every Degree of Anomaly, will be common Multipliers; by which multiplying the tabular Increment, gives the true, as before: And by this Method were the Multipliers computed to the Increments of the Second and Variation Equations.

The next Equation to be encounter'd with, being the Elliptic, the first Thing taken under Consideration, was the common Proportion for obtaining the mean from the true Anomaly: viz. *As the Apogeal Distance is to the Perigeal, so is the Tangent of half the mean to the Tangent of half the true Anomaly. The Apogeal Distance is the Eccentricity added to the mean Distance of the Moon from the Earth; suppose* 1,000,000 *Parts: And the Perigeal Distance is the same, subtracted from the said mean Distance: This being*

* *Vide* Chronologer,

being done with the respective † Eccentricity *to each Degree of* * *Annual Argument; by adding the Arithmetical Complement of the Log. of each Apogeal Distance, to the Log. of the Perigeal; there will thereby be obtained a Table of constant Logarithms, to be at all times taken out, as the Eccentricities* p. 140. *and in this manner was the Table constructed* p. 257; *the Use of which you have in* p. 145, &c.

Upon shewing these constant Logarithms to an ingenious Friend and Acquaintance Mr. William Beetenson, *of* Exeter-street, *Surgeon, he believed he had the same Numbers by him in Manuscript, but upon comparing, we found a small Difference only between some of them in the last Place to the Right-hand, occasioned by the like Differences in the Eccentricities from which mine were computed.*

In the same Manuscript were likewise contain'd several Radices of the Sun, with the Motion of his Apoge and Anomaly for stated Times; where finding the Apoge of the Sun to be about 7 *min. short of what it is made by all other Tables extant, which corresponding with the latest Observations, I therefore compos'd all the Solar Tables agreeable thereto.*

The Motion of the Apoge of the Sun for a Year, is now observed to be 1′. 0″. 40‴, *but by Mr.* Flamsteed's *Tables it is made* 1′. 3″; *such*

† See p. 140.
* *Viz.* Moon's Apoge first Time Equated à Sun.

ſuch a Difference in Proceſs of Time will amount to a conſiderable Error.

But to return to the Elliptic Equation of the Moon; the next thing was to diveſt the ſame from the Logarithmic Operations, as directed p. 145, &c. *for which Purpoſe the Table of the mean Elliptic Equation,* p. 218. *was conſtructed, as alſo thoſe for the Reduction of the mean to the true Elliptic Equation to every other Degree of * annual Argument, and was at firſt to every three Degrees of Anomaly; but finding, that if the ſaid Reduction-Table was compiled to every Degree of Anomaly, the Tablet-Work,* p. 134. 154. *might be greatly ſhorten'd: I accordingly computed it thereto, by which the ſaid Reduction may at all times be obtained with ſcarce any more Trouble than bare Inſpection.*

The Tables, according to Mr. † Machin, *were conſtructed from his Numbers, given in his Treatiſe of the* Laws of the Moon's Motion, *annexed to the latter End of Sir* Iſaac Newton's Principles *in* Engliſh, *where he makes an Equant, to be applied to half the mean Anomaly, for obtaining the Elliptic or Equation of the Moon's Centre, amounting when greateſt to* 2 *Minutes,* 2 *Seconds, and tho' Sir* Iſaac, Lib. I. Prop. 31. *gives a Law for obtaining ſuch Equant, yet he no where takes notice of it in the* Theory, *but directs the ſaid Equation of the Centre to be found by the common Methods* (Prin. En. Vol. II. p.

* Diſtance of Moon's Apoge firſt Time Equated à Sun.

† See p. 213. 214. 215. 216. 265.

p. 302.) *by which it appears, as if ſome of the ſeven Equations were uſed only as an Approximation, for which this Equant might compenſate.*

The moſt eſſential Equations of the ſeven, are the Annual, Elliptic, and Variation; the Sum of the other four when greateſt amount to a little above 9′, *the Difference between which Sum and the Double of this* † *Equant alſo when greateſt is* 5 *Minutes, this Error the* Theory *is often found liable to; and by the ſame Reaſoning, ſhould be likewiſe to their Sum*, viz. 13′, *which ſometimes it has not been far ſhort of.*

Hence, making uſe of no more than the Annual, Elliptic, and Variation Equations, from the Tables according to Mr. Machin, *in computing the Lunar Eclipſe*, March 15. (*the Radical Year*) 1736, *the Computus will be found to correſpond exceeding near to Obſervation; whereas if other Equations be introduced, which in this caſe are only the* * *ſecond and ſixth, the former amounting to above* 3′ *ablative, and the latter to about* 2′ *alſo ablative, it will thereby make the ſaid Eclipſe to fall about* 10 *Minutes in Time ſhort of Obſervation: And as both the ſaid Equations are Ablatives, it is a corroborating Teſtimony, that they are altogether unneceſſary in the Syzygys.* See *the Computus, at the End of the Book.*

Alſo in computing the Place of the Moon for the Occultation of Aldebaran, Dec. 12. 1738.

† See p. 145 and 147.
* The third and ſeventh vaniſhing.

1738. *by making uſe of the aforeſaid three Equations only, that of the Reduction to the Ecliptic excepted, the ſame will be found to correſpond with Obſervation; when, if it be computed according to the* Theory, *it will be found to fall ſhort about 7′ in Time; which is a farther Proof that no more of the Equations are neceſſary either in or out of the Syzygys, as has been often verified by ſundry Obſervations of the Moon on the Meridian, which I received from my Friend* John Bevis, *M. D.*

If Computations by this Method be compared with a proper Set of Obſervations, and ſhould be found to deviate therefrom, Rules for obtaining the Moon's Place à poſteriori *may from thence be deduced; but to have it* à priori, *muſt remain among the* Deſiderata, *'till ſome great Genius ſhall oblige the World with a farther Diſcovery than has hitherto been made; but this is expected in the* Theory *of* Gravity, *promiſed by that excellent Mathematician, the aforeſaid Mr.* John Machin, *Profeſſor of* Aſtronomy *in* Greſham College, &c.

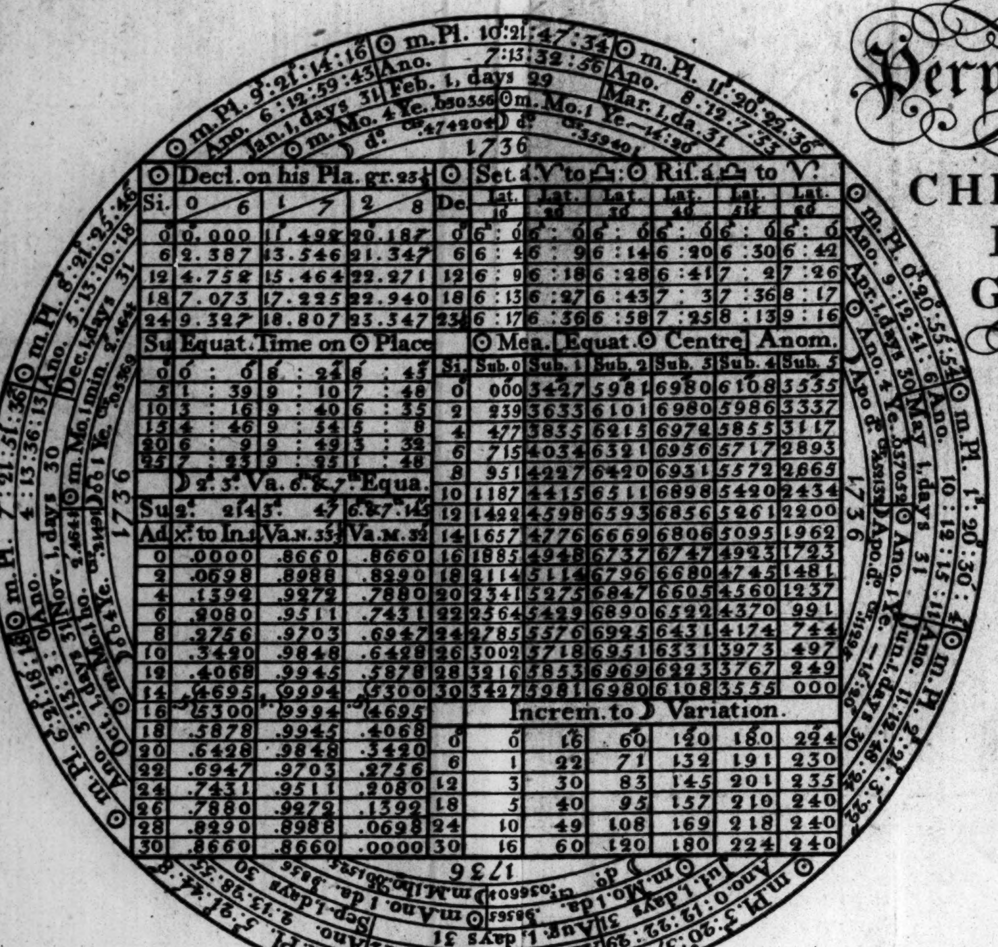
The Knowledge of Decimal Arithmetic being abſolutely neceſſary in the Uſes of the Chronologer, *and finding alſo that this Treatiſe might thereby be made independent of any other, gave occaſion for introducing the Theory thereof.*

The

The Doctrine of Circulating Numbers might with greater Propriety (if those who first gave Name thereto had thought fit) have been called Novenal Arithmetic, as others are called Decimal, Duodecimal, &c. the first being denominated by Nines, the second Tens, the third Twelves, &c.

I shall conclude this Preface with observing, that there seems to be wanting Tables and Methods similar to these, whereby the Places of the Planets may be computed with the like Ease and Expedition; how much such a Work may be acceptable a little Time will determine, when, as the same is already in Embrio, it may probably at a convenient Opportunity be brought forth.

Me. Mot.	Me. Mo. ☉	☉ Me. An.°	Me. Mo. ☽	Me. Mo. ☽ Ap	Me. Mo. ☽ ☊
4 Years	$.\overset{\circ}{0}3038$	$.\overset{\circ}{0}37052$	Cir. .474204	Cir. .452132	Cir. .21491
1 Year	$-14' : 20''$	$-15' : 20''$	Cir. .359401	Cir. .11295	Cir. .05369
1 Day	$.\overset{\circ}{9}8565$	$.\overset{\circ}{9}8560$	Cir. .036601	$6' : 41''$	$3' : 11''$
1 Hour	$\overset{\prime}{2}.46412$	$\overset{\prime}{2}.46412$	Cir. .001525	$17''$	$8''$
1 Min.	$\overset{\prime\prime}{2}.46412$	$\overset{\prime\prime}{2}.46412$	X.^{r} 1.^{t} Eq. .104	X.^{r} 1.^{t} Eq. .18	X.^{r} 1.^{t} Eq. .077



Perpetual CHRONOLOGER

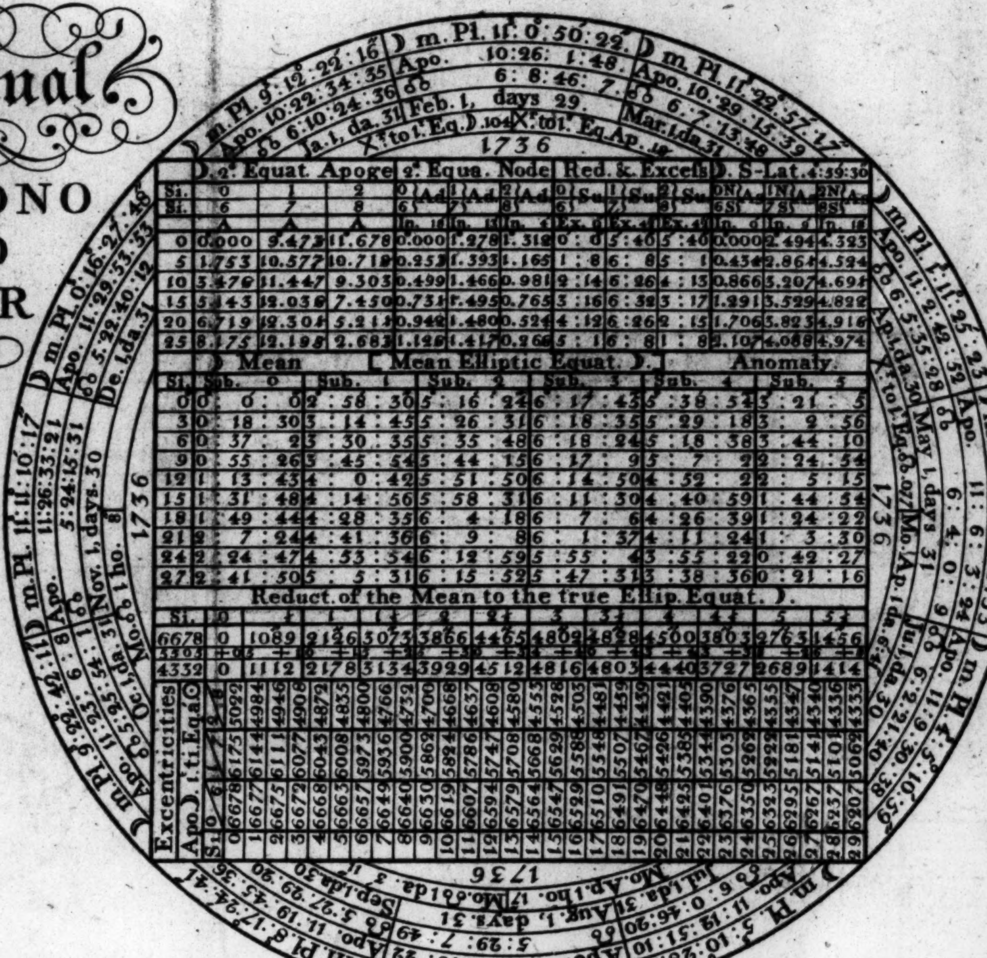


Table to find the Dominical Letter for ever by the Cycle of the Sun.

GF	1	BA	5	DC	9	FE	13	AG	17	CB	21	ED	25
E	2	G	6	B	10	D	14	F	18	A	22	C	26
D	3	F	7	A	11	C	15	E	19	G	23	B	27
C	4	E	8	G	12	B	16	D	20	F	24	A	28

A	B	C	D	E	F	G
Jan. 1 Oct. 1	May 1	Aug. 1	Feb. 1 Mar. 1 Nov. 1	June 1	Sep. 1 Dec. 1	Apr. 1 July 1
Adv. Sun.	Adv. Sun.	Adv. Sun	Adv. Sun	Adv. Sun.	Adv. Sun.	Adv. Sun.
Dec. 3	Nov. 27	Nov. 28	Nov. 29	Nov. 30	Dec. 1	Dec. 2

Ad. 9 to Ye. X^t. div. by 28 rem. Cyc. ☉: Ad. 1 to Ye. X^t. div. by. 19 rem. is Prime

Shr. Sun. is 7 We. bef. Eaf. Afc. 39^th day. W^t. Sun. 7 We: Trin. Sun. 8 We. af. Eafter

Eaf. Term beg. 17^th day af. Eaf. Con. 27 da^s.	Trin. Tm. beg. 5^th day af. Trin. Con. 21 da^s.
1^t Ret. 14^th day af. Eafter.	1^t Ret. on the Morrow of Holy Trin.
2^d. 21^st. d^o.	2^d. 7^th day af. Holy Trin.
3^d. 28^th d^o.	3^d. 14^th. d^o.
4^th. 35^th. d^o.	4^th. 21^t. d^o.
5^th. on the Morrow of the Afcenfion.	Ret. King's Bench 3 days af. thofe.

To find Eafter for ever by the Prime and Dominical Letter.

Prime	A	B	C	D	E	F	G
I	Apr. 9	Apr. 10	Apr. 11	Apr. 12	Apr. 6	Apr. 7	Apr. 8
II	Mar. 26	Mar. 27	Mar. 28	Mar. 29	Mar. 30	Mar. 31	1
III	Apr. 16	Apr. 17	Apr. 18	Apr. 19	Apr. 20	Apr. 14	15
IIII	9	3	4	5	6	7	8
V	Mar. 26	Mar. 27	Mar 28	Mar. 29	Mar. 23	Mar. 24	Mar. 25
VI	Apr. 16	Apr. 17	Apr 11	Apr. 12	Apr. 13	Apr. 14	Apr. 15
VII	2	3	4	5	6	Mar. 31	1
VIII	23	24	25	19	20	Apr. 21	22
IX	9	10	11	12	13	14	8
X	2	3	Mar. 28	Mar. 29	Mar. 30	Mar. 31	1
XI	16	17	Apr. 18	Apr. 19	Apr. 20	Apr. 21	22
XII	9	10	11	5	6	7	8
XIII	Mar. 26	Mar 27	Mar. 28	Mar. 29	Mar. 30	Mar. 31	Mar. 25
XIV	Apr. 16	Apr. 17	Apr. 18	Apr. 19	Apr. 13	Apr. 14	Apr. 15
XV	2	3	4	5	6	7	8
XVI	Mar. 26	Mar. 27	Mar. 28	Mar. 22	Mar. 23	Mar. 24	Mar. 25
XVII	Apr. 16	Apr. 10	Apr. 11	Apr. 12	Apr. 13	Apr. 14	Apr. 1[illegible]
XVIII	2	3	4	5	Mar. 30	Mar. 31	[illegible]
XIX	23	24	18	19	Apr. 20	Apr. 21	2[illegible]

J. Bird Sculp.

THE

The COMPENDIOUS ASTRONOMER.

THE *Young Arithmetician* may observe, that on the outermost Part of the following Figure are contain'd the Names of the Twelve Signs of the Zodiac; and under each Name, the Character and Number of the said respective Sign; which Number shews how far, or

B how

how many Signs each respective Sign is distant from the first Point of the Equinoctial Sign *Aries*; from which Point the Motions and Places of the Sun, Moon, *&c.* are always reckon'd and calculated, *viz.* from *Aries* to *Taurus* is one Sign, from *Taurus* to *Gemini*, two Signs, and so on; which is the Way the Sun, Moon, *&c.* always move. *Lastly*, Under each respective Sign is the Month and Day, wherein the Sun enters the said Sign.

EACH Sign is also divided into Thirty Parts, call'd *Degrees*, and each Degree into Sixty Parts, call'd *Minutes*; each Minute into Sixty Parts, call'd *Seconds*, and each Second into Sixty Parts, call'd *Thirds*, &c.

FROM this Division of the Circle naturally follows this Notation, *viz.* That

60 Thirds	*are equal to*	1 Second	*thus characteriz'd*	Thirds ‴
60 Seconds		1 Minute		″
60 Minutes		1 Degree		′
30 Degrees		1 Sign		°
12 Signs (or 360 Deg.)		the whole Circle.		S. and as in the *Figure*.

THEREFORE in Addition of these Quantities there is only to be observ'd the Common Rule, *viz.* How many of the Lower Denomination make One of the next Superiour? Which will be so many Units, to be carry'd to the next superiour Place, *&c.*

EXAMPLE

EXAMPLE I.

S.	°	′	″	‴
2	17	44	36	53
1	28	32	25	41
3	17	19	14	12
1	19	59	58	57
9	23	36	15	43

In this Example the Thirds amount to 163, which are equal to Two Seconds and 43 Thirds; which said 43 Thirds being ſet down under the reſpective Place, the Seconds, with the Two carry'd from the Thirds, are 135; which amount to Two Minutes and 15 Seconds; the ſaid 15 Seconds being ſet down, and the Two Minutes carry'd to its reſpective Place, make the Minutes amount to 156; which are equal to Two Degrees and 36 Minutes; the 36 Minutes being ſet down, and the Two Degrees carry'd to the next Place *viz.* of *Degrees*, make up the ſame 83, which are equal to Two Signs and 23 Degrees; which Degrees being ſet down, and the Two Signs carry'd to the next Place, *viz.* of *Signs*, make up their Number 9; and the whole Sum will be, as in the Example above. The like of all others, &c.

It many times happens in *Addition*, the Number, or Sum added up in the Place of Signs, exceeds 12, &c. in which Caſe, the 12, or ſo many times 12 as can be found in the ſaid Number, muſt be rejected, and the Remainder only ſet down.

EXAMPLE II.

S.	°	′	″	‴
6	19	20	30	50
9	16	49	57	59
3	28	59	49	3
8	5	10	17	52

THE Reaſon of Rejecting the 12 Signs, &c. is, as in the Hour-Hand of a Dial we only obſerve how far it is paſt the Hour of Twelve, or Point at Noon, without any regard to how many times it has made its Revolution; ſo in theſe Calculations regard is only to be had to how far the Sun, &c. is diſtant from the Equinoctial Point *Aries*, without any regard to the Number of Revolutions that in any time hath been made thereby.

EXAMPLE III.

	S.	°	′	″	‴
	11	0	13	17	16
	9	29	19	56	59
	10	17	14	13	12
	8	14	25	19	46
Sum	4	1	12	47	13

IN this laſt Example the Sum of the Signs is 40, which contains Three Revolutions, *viz.* 36 Signs, and 4 Signs over; which ſaid Four Signs are ſet down, and the 36 for the above Reaſon, are rejected: And theſe are all the Difficulties you will meet with in *Addition*.

SUB-

SUBTRACTION.

AS in *Subtraction* of other Quantities, so in these; where the Number of the lower Denominations to be subtracted cannot be immediately taken out of those above, or over them, you must borrow one of the next superiour Denomination, and add thereto, in your Mind, that Subtraction may be made, carrying the same on again, as you go, *&c.* which the following Example will clear up.

EXAMPLE I.

	S.	°	′	″	‴
From	4	3	24	13	20
Take	2	6	16	25	30
Rem.	1	27	7	47	50

Here 30 Thirds are greater than 20 Thirds, from which it should be taken: Therefore you borrow One of the next superiour Denomination, *viz.* one Second, or 60 Thirds; which, with the aforesaid 20 Thirds, make 80 Thirds; from which, if you now take the said 30 Thirds, the Difference will be 50 Thirds; which you set down, next the One that you borrow'd, and 25 Seconds, make 26 Seconds, which is to be taken from 13; but, for the aforesaid reason, you must first borrow a Minute, or 60 Seconds from the next preceding Denomination, which will then be 73; from which taking the said 26 Seconds, there remains 47 Seconds; which set down as before, and carrying the One you borrow'd, to 16 Minutes, it makes 17 Minutes, which is now to be taken from 24 Minutes, and there remains

remains 7 Minutes, which ſet down; next, 6 Degrees from 3 Degrees cannot be taken; therefore by borrowing a Sign, or 30 Degrees, one of the next ſuperiour Denomination, it will be 33 Degrees; from which taking the ſaid 6 Degrees, there remains 27 Degrees; which being ſet down, and the One carry'd to the two Signs, makes 3; which taken from 4, there remains One, as above, and the whole Remainder will be as in the *Example*, &c.

As before in *Addition*, the Circle, or Twelve Signs, *&c.* was rejected; ſo here in *Subtraction*, it may happen, that you may have occaſion to borrow the ſame.

EXAMPLE II.

SUPPOSE the Moon to be in the Firſt Point of *Gemini*, or Two Signs, and the Sun to be in the Firſt Point of *Aquarius*, or 10 Signs, and you would know their Diſtance: Here the Sun wants Two Signs of the Circle, and the Moon is Two Signs beyond that Point (or 12 Signs;) ſo that they are Four Signs diſtant. Therefore, if to the Moon's Place, *viz.* 2 Signs, you add the Circle, *viz.* 12 Signs, and from that Sum 14, ſubtract 10 Signs, the Sun's Place, you'll have 4 Signs for their Diſtance, as before. Which gives this General Rule, That whenever *Subtraction* cannot otherwiſe be made, you muſt always take in the Circle, or Twelve Signs, &c.

EXAMPLE

EXAMPLE III.

From	3	25	24	32	23
Take	7	20	29	43	17
Rem.	8	4	54	49	6

As Decimal Fractions are of great use in the following Calculations, I shall next exhibit the Management of them so far as concerns this Treatise, which, by any one tolerably vers'd in *Arithmetic*, will be found full as easy as the Operations of *Integers* or Whole Numbers: For Integers, or Whole Numbers, according to Place, increase or decrease in a decuple, or tenfold Proportion, *viz.* Any integral Digit being mov'd a Place higher to the left hand, signifies (or has a Value) ten times as much as it had in the Place it possess'd before: And, on the contrary, being mov'd a Place lower, to the right hand, it will signify, or have but one tenth Part of the Value it had before.

****

NOTATION.

EXAMPLE I.

10000 Ten thousand, or 1000 multiply'd by 10.
1000 A Thousand, or 100 multiply'd by 10.
100 An Hundred, or 10 multiply'd by 10.
10 Ten, or Unity multiply'd by 10.
1 Unity, or One only.

From

From this Example 'tis obvious, beginning at the Place of Unity, that every aſcending Expreſſion, by the Addition of a Cypher, or Place to the right hand, ſignifies ten times as much as in the preceding ſtate. Therefore adding, or annexing a Cypher (*viz.* a Place) to the right hand of any Integral Expreſſion, is multiplying the ſame by Ten; two Cyphers, by an Hundred, &c.

From whence 'tis alſo plain, if you begin at the Head, or uppermoſt Row of the Example, every ſubſequent Expreſſion is but a tenth Part of the preceding, which (as has been obſerv'd) is perform'd by ſeparating a Cypher, or Place to the right hand therefrom.

EXAMPLE II.

10000	Signifies, as above, *viz.* Ten thouſand.
1000	0 One tenth Part thereof.
100	00 One *Tenth* of the one 10*th*, or one 100*th*.
10	000 One 10*th* hereof again, or one 1000*th*.
1	0000 One 10*th* of *ditto*, or one *Ten thouſandth*.

In this Second Example every ſubſequent deſcending Expreſſion ſignifying but one tenth Part of what it did in the preceding State. Therefore the ſeparating a Cypher, or Place from any Integral Expreſſion to the right hand, is dividing the ſame by Ten; ſeparating two Cyphers, or two Places, is dividing it by an Hundred, &c.

From theſe Examples 'tis evident, that the Operations in Integers are perform'd by a Decimal Computation.

EX-

EXAMPLE III.

10001 Signifies Ten thouſand and one.
1000.1 *ditto* divided by 10
100.01 *ditto* —— 100 } (*or laſt divided by* 10)
10.001 *ditto* 1000 } *ditto.*
1.0001 *ditto* 10000 } *ditto.*

Here, as in the laſt Example (where the Places ſo pointed off were all poſſeſs'd by Cyphers) every Expreſſion deſcending ſignifying but a tenth Part of what it did in the preceding ſtate; it follows, that Unity, the laſt Digit to the right hand in the firſt, or Integral ſtate, will in the Subſequent ſignify but a tenth Part thereof in the next Subſequent, but a tenth Part of what it did in the former, or an hundredth Part of what it did in the firſt; and ſo on

These Places ſo pointed off, are call'd *Decimal Fractions*; and to diſtinguiſh them from Integers, they are always noted, and ſeparated therefrom by a Point, or Comma, plac'd before them to the left hand, as above.

CONSECTARY I.

By this Example 'tis very eaſy always to diſcover the Diviſor, (which is alſo call'd the Denominator) to any of theſe Fractions: For when the Fraction conſiſts but of One Place, as in the firſt deſcending ſtep in the above Example, it is there, as you find, divided by Ten, *viz.* Unity, with One Cypher to the right hand thereof; in the next ſubſequent ſtate, where it conſiſts of Two Places, it is there divided by an Hundred, *viz.* Unity, with Two Cyphers to

 the

the right hand thereof, *&c.* Which gives this General Rule, *viz.* So many Places as the Fraction consists of, so many Cyphers with Unity prefix'd to them (as in the Example) is ever the Divisor, or Denominator to the said Fraction.

CONSECTARY II.

It is also evident, that prefixing a Cypher, or Place to any Decimal Expression is, when pointed off, dividing tht same by 10, *&c.* (*Vide First and Second State descending*, &c.)

CONSECTARY III.

From these two last Observations 'tis obvious, that to divide any Integral Expression by Unity with Cyphers to the right hand thereof (which is likewise to be Integral) you must point off so many Places to the right hand from the said Integral Expression to be divided, as are the Number of Cyphers following the said Unit. And when the Number of Places in the aforesaid Integral Expression are less than the Number of Cyphers to the right hand of the said Unit, you must prefix so many Cyphers thereto, as will make the Number of Places therein equal to the Number of Cyphers following the said Unit: Consequently, if the Expression to be so divided, be a Decimal only, so many Cyphers as succeed the said Unit, must be prefix'd to the said Decimal Expression, which when pointed off, will be the Decimal Expression requir'd, *&c.*

CON-

CONSECTARY IV.

If to the laſt Decimal Expreſſion deſcending in the preſent Example, another Cypher was to be prefix'd, it preſuppoſes the ſaid Cypher to have exiſted immediately after the Unit to the left hand, in the firſt or Integral ſtate; or, which is the ſame thing, immediately after it, in the laſt, previous to its being pointed off. This is obvious from *Conſ.* 1. *viz.* the Diviſor's, or Denominator's conſiſting of ſo many Cyphers with the Unity prefix'd thereto, as are the Number of Places of any Decimal Expreſſion, *&c.*

CONSECTARY V.

As every Expreſſion deſcending is but a Tenth of the Preceding, by beginning at the lowermoſt Place in the preſent Example, 'tis plain, that every aſcending Expreſſion is ten times the Value of the next below it, *viz.* It is the *next* Lower multiply'd by 10, the next Aſcending is this laſt again multiply'd by 10, or the lowermoſt multiply'd by 100, *&c. viz.* It is the lowermoſt multiply'd by Unity, with ſo many Cyphers to the right hand thereof as are the Number of Gradations you aſcend. But by pointing off a Place to the left hand from the ſaid lowermoſt Expreſſion, it becomes the *next* Aſcending; by pointing off Two, it becomes the *next* Aſcending above that again, *&c.*

CONSECTARY VI.

THEREFORE To multiply any Decimal Expression by Unity with Cyphers to the right hand thereof (Integral, as before) you must point off so many Places to the left hand therefrom, as are the Number of Cyphers following the said Unit; which Places so pointed off, will possess the Integral Side of the *Example*: Therefore, if possess'd by any Digits, *&c.* they will be Integers; consequently, when the Number of Cyphers following the said Unit are equal to the Number of Places in the *Decimal Expression* to be multiply'd thereby, the said *Decimal Expression* will become all Integral; and when they are more, the remaining Cyphers must, as in Example I. be annext to the right hand of the aforesaid *Decimal Expression*, which now, as in the last Case, will be likewise all Integral.

CONSECTARY VII.

IT is obvious, that the Digits expressing these Fractions, have, beside their own single Value, as in Integrals, another, according to the Place they possess, *viz.* Unity in the first descending state of the present Example, where it possesses the first Place, when pointed off to the right hand, signifies one tenth Part; in the next, where it possesses the second Place to the right hand, it signifies one hundredth Part; in the next, or third Place, one thousandth Part, &c. Wherefore, if a Cypher or Cyphers follow the said Unit to the right hand, the Value thereof will not be increas'd thereby: For while it possesses the same Place, it will ever

ever express or retain the same Value, the following Cyphers, *&c.* only signifying, that no Digits possess those Places, *&c.* These Places, besides *Tenths*, *Hundredths*, *Thousandths*, &c. are also call'd *Primes*, *Seconds*, *Thirds*, &c.

CONSECTARY VIII.

By comparing these Fractions with the Integrals to the left hand of 'em, as in the Second state descending of the present Example. Against 1000 Integral, you have .1 Decimal; in the next subsequent state, you have 100 Integral, *viz* one tenth Part of the preceding 1000, and .01 Decimal, one Tenth also of the preceding .1, *&c.* Whence, (as is also plain from the very *Notation*, the same Law taking place in these Fractions, both in Ascending and Descending) As in *Integrals*, it follows, That as *Ten*, or so many *Tens* as are in any inferiour Place of *Integrals*, make an *Unit*, or so many *Units*, in the next superiour Place, *&c.* the same must also follow true of these Fractions, *viz.* the Operations of *Addition* and *Subtraction*, and consequently, *Multiplication* and *Division*, will be the same as in *Integrals*, and only differ in Name, *viz. Integers*, or *Wholes*; *Decimals*, or *Parts*. vide Exam: the following

Addi-

Addition *of* DECIMALS.

EXAMPLE I.

Here I shall resume the following Numbers from *Notation, Example* III. *viz.*

Integrals.	*Decimals.*	*2d Operation.*
1000	.1	.1000
100	.01	.0100
10	.001	.0010
1	.0001	.0001
Sum 1111	*Sum* .1111	*Sum* .1111

Thus in the Integral Part, the Unit in the second State descending, where it signifies an Hundred, is put under the Place of *Hundreds* in the uppermost State, before it can be added; as also in its proper Places in the other descending States. So also the like Method is observ'd in the Decimal or Fractional Numbers, of placing like Places under like Places; which done, being added, as if Integrals, and the Number of Places in the Sum equal to the Number of Places in the greatest Row of Decimals to be added, being pointed off to the right hand, give the true Sum, as above.

*Conf 7. As * Cyphers to the right hand of any Decimal Expression do not increase the Value thereof, in the *Second Operation*, they are supply'd, till equal in Number of Places to those in the greatest Row to be added, which in the *First Operation* was done Mentally.

Let

EXAMPLE II.

LET it be requir'd, to add into One Sum, the following Decimals, *viz.* 0342* + .12 + 007 + 00006, due regard being had to placing like Parts under like Parts, &c. It is not material which Row of Decimals is plac'd first.

Mentally.	*Supply'd.*
.007	.00006
.12	.03420
.00006	.12000
.0342	.00700
.16126 *Sum.*	.16126

As the Number of † Tens in any inferiour lace, are so many Units in the next Superiour, hen in the Place of Tenths, or Primes, the same all so happen, the said Number of Tens will become so many Integers, &c.

EXAMPLE III.

.4567	.98765
.7854	.39784
.6543	.99999
1.8964	2.38548

THESE last Sums are call'd *Mixt Numbers*, as nsisting both of Integrals and Fractional Parts, in ddition of which they fall under the General ule, of placing like Places under like Places: hen, to Add, as above, &c. EX-

* *This* + *Character is call'd* more, *and signifies, that the Number following it is to be added.*

† Ex. 3. Consec. 8. *Notation.*

EXAMPLE IV.

7894.054	7894.05400
678.983	0678.98300
99.8	0099.80000
7.71256	0007.71256
Sum 8680.54956	*Sum* 8680.54956

****

SUBTRACTION *of* DECIMALS.

HERE, as in *Addition*, regard must be had placing like Places under like Places: Nex proceed as in *Integrals*, pointing off so many Pl ces to the right hand in the Remainder, as a the greatest in Number, whether in the *Minue* or *Subtrahend*.

EXAMPLES.

	(I.)		(II.)	
Minuend	.7321	From	.94327	From
Subtrahend	.5432	Take	.88158	Take
Remains	.1889	*Rem.*	.06169	

(III.)	(IV.)	(V)
.23	102.786	34.56789
.17604	101.778	17.5
.05396	1.008	17.06789

In the *Third Example*, where the Number of Places in the *Minuend* are less than in the *Subtrahend*, there Cyphers, as in *Addition*, are Mentally suppos'd. In the *Fifth Example*, the like is to be understood in the *Subtrahend*, &c.

MULTIPLICATION *of* DECIMALS.

Multiplication here, as in Integrals, is the Addition of many Equals; the Rules of which will be best clear'd up by *Examples*.

EXAMPLE I.

CASE I.

Let it be requir'd, to Multiply 4, an Integer, by .5, a Decimal. Here .5, the *Multiplier*, is .5, divided by 10, as is plain from the foregoing *Notation*. Therefore the Product of 4 by .5 must also be divided by 10; which is done, by * pointing off one Place of the said Product to the right hand; which being possess'd by a Cypher, the Product will therefore be 2.

* Ex. 2. Conf. 3. *Notation*.

4	*Multiplicand.*
.5	*Multiplier.*
2.0	*Product.*

CASE II.

AGAIN, As *Multiplication* is only the Addition of Equals, and in *Multiplication* it matters not which Factor is made the * *Multiplier*; let the aforesaid .5 be added up four times together, which makes twenty Tenths: But the Number of † Tens in the Place of Tenths becomes Integral; which here being Two, the Sum is therefore 2.0, equal to the above Product.

* *Euclid, lib.* 7. Prob. 16.
† Ex. 3. Conf. 8. *Notat.*

Operation.

.5
.5
.5
.5

Sum 2.0 *Equal to the above Product.*

CASE III.

Lastly, IN the present Example, the *Multiplier*, viz. .5, or 5 divided by 10, signifies, that 5 tenth Parts of 4, the *Multiplicand*, is to be taken. If therefore the said *Multiplicand*, viz. 4, be divided by 10, the *Denominator* of the *Multiplier*, which is perform'd by † pointing it, &c. and the same be now multiply'd by 5 Integral, as the Question imports, you will likewise have the true Product.

† Ex. 3. *Notat.* Conf. 3.

.4 *Multiplicand.*
5 *Multiplier.*

2.0 *Product*, &c. as *per Case* 2.

EXAMPLE

EXAMPLE II.

LET it be requir'd, to multiply 234, Integral, by .23, Decimal.

HERE, by the last *Case*, the Import of the Question is, that 23 hundredth Parts of 234, the *Multiplicand*, are to be taken: Wherefore, according to the said Rule, if the *Multiplicand* be divided by 100, the *Denominator* of the *Multiplier*, &c. it will be * 2.34, which now is to be added up 23 times together (that is the same as being multiply'd by 23;) but as in *Addition* there must be so many Places pointed off, as are in the greatest Row of the *Factors* to be added; which here, are only Two, and equal in every *Factor*, &c. Therefore there will be but Two Places to be pointed off in the said Sum; or, which is the same, from the *Product* made by the Multiplication of the above Numbers, equal to the Number of Places at first in the said *Multiplier*; which gives this Rule, *viz.* When an Integral Number is to be multiply'd by a Decimal; and the contrary, when a Decimal is to be multiply'd by an Integral, you must point off so many Places in the *Product*, as are in the *Decimal Fraction* so Multiplying, or Multiply'd.

* Ex. 3. *Notation.* Conf. 3.

EXAMPLE III.

LET it be requir'd to multiply 12 *Integral*, by .005 *Decimal*.

* Ex. 1. Cafe 3. † *Notat.* Ex. 3. Conf. 1, 3. || Ex. 2.

Here the *Multiplicand* being divided by the * *Denominator* of the *Decimal Multiplier*, viz. .1000, it becomes † .012; which now is to be multiply'd by 5, Integral, and the *Product* will confift of || three Decimal Places. (*Vide* the *following Operations.*)

† Ex. 1. Cafe 2.

Operation 1.	*Operation* 2.	*Operation* 3.
12	.012	.005
.005	5	12
60	.060	.060

The *Product* in the Firft Operation, which is perform'd according to the common Method, confifts of a Place lefs than in the other Operations, which are the True; but the *Product* in the Firft Operation is the *Multiplicand*, 12 into 5, an Integral; which is but really 5 divided by 1000, as above: Therefore the *Product*, which is now an Integral, muft be divided by * 1000; which will thereby become † the true *Product*, as in the other Operations.

* Ex. 1. Cafe 1. † *Notat.* Ex. 3. Conf. 3.

Which gives this Rule, *viz.* When any Integral is to be multiply'd by a Decimal, or Decimal by an Integral, and the Number of Places in the *Product* are lefs than the faid Decimal Places, you muft prefix fo many Cyphers to the faid *Product* as will make them Equal.

EXAMPLE

EXAMPLE IV.

LET it be requir'd to multiply .16, a Decimal, by .9, a Decimal.

Operation 1.	*Operation* 2.
.16	.016 +, &c.
.9	9
.144	.144

FROM this Example, 'tis demonstrably seen, that in multiplying a Decimal by a Decimal, so many Places must be pointed off in the *Product* for Decimals, as are the Number of Decimal Places, both in the *Multiplicand* and *Multiplier*.

EXAMPLE V.

LET it be requir'd to multiply .12 Decimal by .12 Decimal.

Operation 1.	*Operation* 2.
.12	.0012 *
.12	12
.144	.0144 *true Product*.

* Ex. 3. Case 3, &c.

FROM this Example, 'tis likewise demonstrably evident, that when the Number of Places in the *Product* are less than the Decimal Places, both in the *Multiplicand* and the *Multiplier*; you must, as in *Example* 3, prefix Cyphers thereto, till made equal; which pointed off, will be the true *Product* requir'd.

EX-

EXAMPLE VI.

Let it be requir'd, to multiply 24.3 (which is call'd a *Mix'd Number*, as consisting both of Integral and Decimal Places) by 2.43, also a Mixt Number.

Here 2.43, the *Multiplier*, is 243 Integral, divided by * 100. Therefore 243 hundred Parts of 24.3, are only to be taken.

* Notat. Ex. 3. Conf. 1, 3.

Next, If the † *Multiplicand* be divided by 100, the *Denominator* of the *Multiplier*, that the same may be us'd Integrally, there must two more Places for Decimals (|| by prefixing Cyphers, if requisite) be pointed off, to that already in the *Multiplicand*. Wherefore the *Product* will consist of * three Decimal Places; but the two Places thus pointed off in the *Multiplicand*, are equal to those before in the *Multiplier*; which, as is evident, will always be the Case in other Multiplications, &c.

† Ex. 1. Case 3.

|| Notat. Ex. 3. Conf. 3.

* Ex. 2.

From whence flows this General Rule in all Cases, *viz.*

Multiply, as if all were Integrals; and from the *Product* point off so many Places for Decimals, as are the Decimal Places, both in the *Multiplicand* and *Multiplier*; and when the Number of Places in the *Product* are less than the Places in the *Multiplicand* and *Multiplier*, you must prefix Cyphers thereto, till they become equal; which, when pointed off, will be the true *Product* requir'd.

Opera-

Operation 1.	*Operation* 2.
24.3	.243
2.43	243
729	729
972	972
486	486
59.049	59.049

EXAMPLE VII.

LET it be requir'd, to multiply 23.456 by 23.456.

Operation 1.	*Operation* 2.	
23.456	.023456	Ex. 1.
23.456	23456	Case 3.
140736	140736 *	* Ex. 2.
117280.	1.17280. *	
93824..	9.3824.. *	
70368...	70.368... *	
46912....	469.12.... *	
550.183936	550.183936	

IN the Second Operation, the *Multiplicand* consists of Six Decimal Places; which being added up so many times to its self, as the *Multiplier* (which is now Integral) expresses, the Sum (which is also the *Product*) will likewise consist of Six Decimal Places (*per* Example 2. and *Addition*) equal to those, according to the Rule in the First *Operation*, &c.

Of

Of CONTRACTION *in* Multiplication *of* DECIMALS.

IN Multiplication, when in the *Multiplicand* and *Multiplier* there are many Decimal Places, the *Product*, which always conſiſts of as many Decimal Places, at leaſt, as are in both, will thereby be very numerous, when two or three ſuch Places, *&c.* are moſtly ſufficient for the Purpoſe ; in order therefore to abbreviate ſuch Operations, obſerve the following Rule.

PLACE the Unit's Place of the *Multiplier* (if the ſame is poſſeſs'd by a Cypher, 'tis the ſame thing) under that Place of Decimals in the *Multiplicand*, as you would have the Number of Decimal Places in the *Product* to conſiſt of, *viz.* under the ſecond or third Decimal Place in the *Multiplicand*, when you would have two or three Decimal Places in the *Product*, &c.

NEXT, If there are any Integers to the left hand of the ſaid Unit's Place, they muſt all be inverted to the right hand thereof, and the Decimals before, to the right hand of the ſame, muſt all be inverted to the left hand.

IF the Places of the Integral Part, when thus inverted, fall below (to the right hand) the Places of the *Multiplicand*, you muſt annex Cyphers to the right hand of the *Multiplicand*, till they become equal to the ſaid Places of the Integral Part.

THEN

THEN begin, as in the common Way of Multiplication, with the laſt Digit to the right hand; and by it multiply the Digit directly over it (if any poſſeſſes that Place, *&c.*) having a mental regard to what would be carry'd by the Multiplication alſo of the Digits to the right hand thereof; which being added to the aforeſaid *Product*, ſet down the ſame directly under the ſaid multiplying Digit; proceeding on multiplying the reſt of the Digits to the left hand in the *Multiplicand*, as in other Multiplications.

explained [redacted] in the succeeding Paragraph, & 2: of P. 29.

OBSERVE the ſame Rule with the next Digit in the *Multiplier*, ſetting nothing down, but from the Multiplication of the Digit directly over it; which then muſt be ſet down directly under the laſt Place to the right hand of the aforeſaid firſt *Product*, and ſo on, as before. Proceed in like manner with all the other Digits in the *Multiplier*; when finiſh'd, the Number of Places of Decimals in the *Multiplicand*, unto which the Unit's Place of the *Multiplier* was ſo plac'd incluſive, being pointed off from the Sum of thoſe ſeveral *Products*, gives the true Product requir'd.

EXAMPLE VII.

Let it be requir'd, to multiply 23.456 by 23.456, the last Example, so that there may be only Two and Four Places of Decimals in the *Product*, which otherwise, by the Rule, would be Six.

23.456		23.45600
65432		65432
46912		4691200
7037	vide Page 31. Par. 2 gph	703680
938		93824
117		11728
14		1407
550.18		550.1839

As the Reason of this Rule is not altogether clear, from comparing these Examples with those wrought at large, in the last Example, I shall exhibit a Demonstration thereof.

Altho' in Multiplication of Integrals it be a receiv'd Rule, always to begin at the Unit's Place in the *Multiplier*; yet it is not necessarily so: For you may likewise begin at the last Place to the left hand. [*Vide* the *following Example.*]

EXAMPLE VIII.

LET it be requir'd, to multiply 243, Integral, by 243, Integral.

Operation 1.	*Operation* 2.
243	24300
243	342
486..	48600
972.	9720
729	729
59049	59049

IN the Firſt Operation, the Multiplication is begun with the laſt Place (which is the higheſt) to the left hand; but the 2 there is 200; therefore there are two Cyphers ſuppos'd to the right hand of the *Product* made thereby, &c. and is the Reverſe of the cuſtomary Method.

IN the Second Operation, the *Multiplier* is there inverted, and the two Cyphers added to the *Multiplicand*, is * multiplying the ſame by 100; which being alſo multiply'd by 2, gives the ſame; multiply'd by 200, as in the firſt Operation, next operating with the 4, and beginning at the Place directly over it, which is the firſt *Multiplicand*, multiply'd by † 10, and this again by 4, is the ſame as in the Firſt multiply'd by 40, &c. which clearly demonſtrates the former Rule, as to the Integral Part.

* *Notation*, Ex. 3. Connec. 3.

† *Ibid.*

Next, To demonstrate the Fractional Part of the Rule, I shall resume the last Example, as follows, where the *Product* is to consist of Two Decimal Places.

EXAMPLE IX.

Operation 1.	*Operation* 2.
23.456	23.456
23.456	65432
469.12	469.12
70.368	70.37 v. P. 31. Par.
9.3824	9.38 v. P. 29. Par.
1.17280	1.17
.140736	.14
550.183936	550.18

In the First Operation, which is perform'd according to Example 8. the highest Digit to the left hand, *viz.* 2, is really 20. The Multiplicand therefore being multiply'd by 10, and that Product again by 2, gives the first Product; but the said Multiplicand is multiply'd by 10, by * pointing off to the left hand .4 (which is here done mentally) the Digit that possesses the Place of *Primes* in the Decimal Part of the said Multiplicand; consequently, the said first Product will consist but of two † Decimal Places, to which the inverted Rule also corresponds.

* *Notat.* Ex 3. Cons. 6.

† Ex. 2.

Next, As *per* the Question, the Product is to consist but of Two Decimal Places in the whole; therefore in multiplying by the other Digits, as in

in the firſt Operation, all the Places deſcending to the right hand, below the two ſaid Decimal Places in the firſt *Product*, might have been omitted, as in the inverted Operation.

In both theſe Operations, the Multiplier is really conſider'd Integrally, *viz.*

The two firſt Products, in the Firſt Operation, are made by 23, the Integral Part of the Multiplier; next that, .4, in the place of *Primes*, of the ſaid Multiplier, may alſo be us'd Integrally *; 3, the Integral Digit, in the Unit's Place of the Multiplicand, muſt be pointed off (*viz.* here, mentally) to the right hand in the ſaid Multiplicand, which will thereby conſiſt of Four Decimal Places; and ſo many ſuch Places does this *Product* alſo abſolutely poſſeſs; beyond which, to the left hand, it will be Integral: The like is to be conſider'd of the ſeveral other Products.

* Ex. 1. Caſe 3.

But, as in the reſult of all theſe Products, there are only two Decimal Places to be concerned; therefore no notice is to be taken at any time (but only of the Carriage by ſuch Multiplication) of what ariſes from the Multiplication of the Digits below the two leading Decimal Places in the ſaid Multiplicand, of which, the Place laſt mentally pointed off, is always the firſt leading Place. In the preſent Caſe, 3, the firſt Integral Digit, being thus pointed off, that .4, the Multiplying Digit, may be us'd Integrally, the two leading Decimal Places will then be .34; under which laſt place, the multiplying Digit 4, in the inverted Operation directly falls; with which proceeding according to the Rule, taking in at the ſame time the Carriage (which is almoſt done by Inſpection) that

that ariſes from the Multiplication of the Digits to the right hand of the ſaid two leading Places in the Multiplicand, gives the *Product* requir'd, as in the ſaid inverted Operation.

THAT the Digit 5 in the Multiplier may alſo be us'd * Integrally, the next Integral, 2, in the Multiplicand, is now mentally to be pointed off to the aforeſaid 3; and, for the aforeſaid Reaſon, no Decimal Places to be taken notice of for the *Product*, till you come to 3, in the ſaid Multiplicand; under which, 5, the multiplying Digit in the inverted Operation, by being ſo inverted, directly falls.

* Ex. 1. Caſe 3.

THAT 6, the next multiplying Digit, may likewiſe be us'd Integrally, there is requir'd another Integral Place in the Multiplicand, to be pointed off; which Multiplicand conſiſting of no more, a † Cypher muſt therefore be mentally prefix'd, and no Decimal Places taken notice of for the *Product*, till you come to 2, in the ſaid Multiplicand; under which, 6, the ſaid multiplying Digit, in the inverted Operation, directly falls.

† *Notat.* Ex. 3. Conſ. 3.

THUS, As each inverted Place to the left hand, in the Multiplier, requires an Integral Place in the Multiplicand, to be pointed off to the right hand, for a Decimal, it is evident, by always beginning at the Place in the Multiplicand, directly over the multiplying Digit, that the ſame Number of Decimal Places for the *Product*, as at firſt deſign'd by the Unit's Place, will thereby be ſtill kept up; which fully demonſtrates the ſaid Rule.

IN

In the Firſt Operation, all the Decimal Places ſo conſider'd, are ſet down at large in each Product; which compar'd with the inverted Rule, ſerves as a further Illuſtration thereof.

2. When in the Carriage from the other Places of the Multiplicand, below the leading Decimal Places, &c. the Remainder ſhall happen to exceed 5, &c. there, generally, is ſubſtituted an Unit in the next ſuperiour Place, for it; when under, 'tis neglected; as, in the foregoing inverted Operation, multiplying by 3, *viz.* 3 times 6 (the Digit in the Multiplicand, to the right hand of that, directly over the ſaid 3) is 18, *i. e.* 8, and One to be carry'd forward; next, 3 times .5, and the Unit to be carry'd forward, make 16; but ſeeing the 8, which before remain'd, is conſiderably above 5, the ſaid 16 is therefore made 17, (as *per* Example, &c.)

This carefully obſerv'd, as alſo to abate for ſuch Subſtitutions, in the ſucceeding Multiplications, as occaſion requires, you will ſeldom fail to be exact.

EX-

EXAMPLE X.

LET it be requir'd, to multiply 467.5 by .243; ſo that there may be One and Three Decimal Places in the *Product*.

Operation 1.	*Operation* 2.
467.5	467.5
342.0	342.0
935	93500
187	18700
14	1402
113.6	113.602

IN both theſe Operations, the Place of Units is poſſeſs'd by a Cypher; which being plac'd according to the Rule, as above, &c. gives the Products, as requir'd.

THE ſame wrought at large, &c.

```
  467.5
   .243
 ------
  14025
 18700
 9350
 --------
 113.6025
```

Division of DECIMALS.

DIVISION of *DECIMALS*, as in *Integrals*, is the taking or subtracting of one or more Equals from any Number; and is therefore, in all respects, the just Contrary to *Multiplication*.

EXAMPLE I.

Let it be requir'd to divide an Integral Number by a Decimal Fraction only, *viz.* Unity, an Integral, by Unity, a Decimal, one Tenth, or a Prime.

Here the Question imports, How many times is .1, or one Tenth, contain'd in Unity, Integral, or One; or how many times may one Tenth of of an Unit be taken from, or out of the said Unit? It is evident, that it may be taken away ten times; as also, that it is contain'd ten times therein: Wherefore the Quotient will be 10, *viz.* ten times as much, as if the said Integral Unit had been divided by another Integral Unit, which is very plain.

Therefore, after the Division is ended, there is requir'd, to add a Cypher to the right hand of Unity, the Quotient (* which is increasing the same ten times) in order to obtain the true Quotient.

* Notat. Ex. 3. pa. 9
* Conf. 6. 12

OPERATION I.

.1) 1 (10 *true Quotient.*

Or, which comes to the ſame thing, if the ſaid Cypher be annex'd to the Dividend, *viz.* to the right hand thereof, which is increaſing it ten times the Value, as before, and next dividing, as if both were Integrals, the Quote will be the true Anſwer requir'd.

OPERATION II.

Diviſor. Div^d. Quotient.
1) 10 (10

The Demonſtration hereof, as alſo the other Rules in *Diviſion*, are from *Euclid*, *lib.* 7. Prop. 17, *viz.*

If Two Numbers are multiply'd by any Number, the Products made thereby, will have the ſame *Ratio*, as the Numbers had to each other, before they were ſo multiply'd.

The Converſe of which is evident, *viz.*

If Two Numbers are divided by any Number, the Quotients will have the ſame *Ratio*, to each other, as the ſaid Two Numbers had, before they were ſo divided.

But the *Ratio* of Two Numbers is ever expreſs'd by their Quotients:

Therefore, the Quotients of the Numbers under the aforeſaid Circumſtances, will always be equal.

In

In the preſent Example, multiplying the Diviſor by 10, it becomes Unity, * Integral; and that the ſaid *Ratio* may ſtill ſubſiſt, the Dividend muſt alſo be multiply'd by † 10, which will be as in the *Second Operation*, &c. * Notat. Ex 3. Conſ. 6. † Euclid. lib. 7. Prop. 17.

EXAMPLE II.

Let it be requir'd, to divide 1, Integral, by .01, a Decimal.

Here, to make the Diviſor Integral, it muſt be multiply'd by * 100; and that the ſame *Ratio* may likewiſe ſtill ſubſiſt, the Dividend muſt alſo be multiply'd by 100; and the Quotient will be, as in the following Operation. * Notat. Ex. 3. Conſ. 6.

Diviſor.	*Div*^d^.	*Quotient.*
1)	(100	(100

Which gives this Rule, *viz.*

To divide an Integral Number by a Decimal, add ſo many Cyphers to the Dividend, as the Decimal Diviſor contains Places, and divide as in Integrals; and the Quotient will be ſo far the true Anſwer, in Integrals.

EXAMPLE III.

Let it be requir'd, to divide .484, a Decimal, by 4, an Integer.

As before, the Diviſor, ſo here, the Dividend is now to be made Integral; which is, multiplying it by † 1000. Next, to preſerve the ſame *Ratio*, the Diviſor muſt alſo be multiply'd by 1000. If theſe two Products, *viz.* 4000 and 484, be † Notat. Ex. 3. Conſ. 6.

be divided by 4, the significant Digit in the Divisor, the Numbers produc'd thereby, will be 1000, and 121; which, by the Converse Rule, have likewise the same *Ratio*. *Lastly*, The said 121 being divided by 1000, gives † .121, Decimals, the true Quotient, &c. which are equal to the Number of Decimal Places at first in the Dividend.

† *Notat.* Ex. 3. Conf. 3.

EXAMPLE IV.

LET it be requir'd, to divide the said .484, Decimal, by 44, Integral.

BY the Foregoing, the Divisor and Dividend will become 44000, and 484, Integral; both which being divided by 44, the significant Digit in the Divisor, gives 1000, and 11; which said 11, being divided by 1000, gives * .011, the true Quotient requir'd.

* *Notat.* Ex. 3. Conf. 3.

FROM these Two last Examples flows this Rule, *viz.* In dividing a Decimal by an Integral Number, divide as if all were Integrals: Next point off so many Places in the Quotient, for Decimals, as are the Decimal Places in the Dividend; and when the Digits, or Places in the Quotient shall be found deficient, you must prefix Cyphers thereto, till made equal.

EXAMPLE V.

LET it be requir'd, to divide .1, a Decimal, by 16, an Integral.

In this Example, the Dividend being made Integral, the Divisor will become preserving the same *Ratio* 160; the significant Digits of which Divisor, *viz.* 16, will not go in 1, the now Dividend; but by adding an equal Number of Cyphers, to the right hand of both (as shall be found convenient) that the same *Ratio* may still subsist (which is, multiplying them by 10, 100, *&c.*) and then dividing by the significant Digits of the said Divisor, as in the former Examples, you will have the true Quotient requir'd. [*Vide* the *following States.*]

State 1. 16) .1 (*State* 2. 160) 1 (

State 3.

```
(16      (16
1600000) 10000 (625
          96
          --
           40
           32
           --
           80
           (0)
```

100000) 625 (.00625 *true Quitient* *.

* *Notat.* Ex. 3. Conf. 3.

Or, if Cyphers, as found convenient, had been annext to the right hand of the Dividend .1, *viz.* .10000 (which are so many Decimal Places, tho' not possess'd by Digits) and the same divided by 16, the first Divisor, the Quotient 625, according to the Rule, must have two Cyphers prefix'd thereto, to make the Places therein for Decimals, equal to those in the Dividend; which being pointed off, gives the true Quote, as before.

Of

Of MIX'D NHMBERS.

EXAMPLE VI.

LET it be requir'd, to divide 49948.5, by 23.45.

THIS Example, stated *per Example* II. as under, *viz.* the Divisor made Integral, &c. shews, that when in the Divisor the Decimal Places are more than in the Dividend, you must also annex Cyphers to the right hand of the said Dividend, till made equal *, when dividing, as in Integrals, the Quotient will so far be Integral.

* *Vide* Example 1. of this.

State 1. 23.45) 49948.5 (

State 2.

```
2345) 4994850 (2130
        3048
         7035
        (0000)
```

EXAMPLE VII.

State 1.

234.5) 49.9485 (

State 2.

State 2.

2345) 499.485 (.213
3048
7035
(0000)

In this Example, (*State* 1.) where the Decimal Places in the Dividend are more than in the Divisor, there are (*State* 2.) so many Decimal Places pointed off to the left hand, from the said Dividend, as were equal to those in the said Divisor. By which means, the said Divisor (and Dividend so far) become Integral †. Three, the remaining Decimal Places, in the said Dividend, by *Example* III. of this, shews, that so many Decimal Places must be in the Quotient, &c. Which gives this General Rule in all Cases, *viz.*

† *Notat.* Exam. 3. Cons. 6.

Divide, as if all were Integrals *, annexing Cyphers to the right hand of the Dividend, at pleasure, or, as occasion requires; next, pointing off so many Places for Decimals, in the Quotient, as will make them in the Divisor equal to those in the Dividend; gives the true Quotient requir'd; regarding at the same time, (*per Rule*, to Ex. 4, of this) that when the Places in the Quotient are deficient, to prefix Cyphers thereto, till made equal.

* *Per* Ex. 5. of this.

EX-

EXAMPLE VIII.

```
234.5 ) 4.99485 ( .0213
          3048
           7035
          (....)
```

This laſt General Rule being carefully obſerv'd, it will be very eaſy (and is ever neceſſary, before you proceed in your Diviſion) to eſtabliſh the Value of the Firſt Digit of the Quotient; after which, the Values of the following appear by Inſpection.

There is another excellent Method of diſcovering the Value of the Firſt Digit of the Quotient, *viz.*

Observe, in the Product made by the Firſt Digit of the Quotient and Diviſor, under what Place of the Dividend the Unit's Place (tho' poſſeſs'd by a Cypher) in the *ſaid* Product, falls: For of the ſame Value in place with that of the Dividend, will the Firſt Digit of the Quotient ever be.

EXAMPLE I.

LET the Numbers be, as in the Fifth Example.

Operation 1.	*Operation* 2.
16).10000 (625	16 (.10000 (.00625
96	96
——	——
40	40
80	80
(0)	(0)

HERE 6, in the Place of Units, of the Product, *&c.* falls under the Place of Thirds in the Dividend; and proceeding on in the Diviſion, as every ſucceeding Place in the Dividend, gives another Place in the Quotient; it follows, that the Number of Places in the Quotient will be equal to thoſe in the Dividend, from the aforeſaid Place of Thirds incluſive; as, in the First Operation: But by *Example* 4, (of this) if the Number of Places in the Quotient are not equal to thoſe in the Dividend, they muſt be made ſo, by prefixing Cyphers; which, as is plain, from the Second Operation, will always be equal to the remaining Decimal Places to the left hand in the Dividend, from whence the Place of Units in the ſaid Product falls; and conſequently, the Value in Place of the firſt Digit of the Quotient will ever be the ſame with that of the Dividend, under which the Unit's Place in the ſaid Product ſo falls.

To clear this up in *Mix'd Numbers*, take the following Example.

EXAMPLE II.

Operation 1.

12.5) .1 000 (8
100.0
(0)

Operation 2.

125) 1.000 (.008
1000
(0)

In the Firſt Operation, the Place of Units in the Product, &c. which is poſſeſs'd by a Cypher, falls under the Place of Thirds in the Dividend, and conſequently, 8, the firſt Digit, in the Quote, will be of the ſame Value and Place, and muſt therefore have two Cyphers prefix'd thereto, and is conſonant to the laſt General Rule, and which in the Second Operation, where the Diviſor is made Integral, &c. is evidently clear'd up.

This Rule alſo takes place in Integers, or Whole Numbers, as will be evident, from One Example, *viz.*

25) 1000 (40
100
(0)

Here the Unit's Place of the Product, &c falls under the Place of Tens in the Integral Dividend; the firſt Digit of the Quotient will therefore be Tens, *viz.* 4 Tens, or 40, &c.

Of Reduction *of* VULGAR FRACTIONS *to* DECIMALS.

ALL Fractions, but Decimals, are call'd *Vulgar*, and admit the Unit, *&c.* to be divided into any Number of Parts; as, 4, 8, 16, *&c.* and are expreſs'd, as follows.

$$\frac{1}{4}\ \begin{matrix}\text{call'd the } \textit{Numerator}, \\ \textit{ditto, Denominator},\end{matrix}\quad \frac{1}{8} \text{ and } \frac{1}{16}, \textit{\&c.}$$

THE *Numerator* is the Number to be divided, and the *Denominator* is the Diviſor, and expreſſes the Number of Parts the Numerator is to be divided into.

IF the Numerators and Denominators of theſe Fractions be likewiſe multiply'd by one and the ſame Number, the new Numerators and Denominators will ſtill retain the ſame *Ratio* (*Euclid*, *lib.* 7. Prop. 17.)

SUPPOSE, the above Fractions be thus multiply'd by by 2, they will then become $\frac{2}{8}$, $\frac{2}{16}$, $\frac{2}{32}$.

HERE, as $\frac{1}{4}$ and $\frac{2}{8}$ keep ſtill the ſame *Ratio*, the Quotient of 1 divided by 4, will be equal to that of $\frac{2}{8}$, and conſequently, the Value of the Fractions $\frac{1}{4}$ and $\frac{2}{8}$ will be equal. The like of all others.

THEREFORE to reduce a Vulgar Fraction to a Decimal; let both the Numerator and Denominator of the ſame be multiply'd by Unity with Cyphers, *&c.*

NEXT, divide both theſe Products by the ſignificant Digits of the Denominator, and theſe again, as in the Third and Fourth Examples of *Diviſion*, and you'll have the Decimal Fractions requir'd.

EXAMPLE I.

LET it be requir'd, to reduce $\frac{1}{4}$ to a Decimal Fraction.

$$\frac{)\,4\ \ 100\ (\ 25}{)\,4\ \ 400\ (100} \text{ or } .25, \textit{ Decim. Fraction } \text{requir'd}$$

OR, by the Fifth Example of *Diviſion*, by adding a convenient Number of Cyphers, as ſo many Decimal Places, to the Numerator, and dividing by the Denominator, you will alſo have the Decimal Fraction requir'd.

EX-

EXAMPLE II.

LET it be requir'd, to reduce $\frac{1}{16}$ to a Decimal Fraction.

16) 1.00 (.0625 *Decimal Fraction* requir'd.
    40
     80
     (0)

IN this Example, when the Value of the First Digit of the Quote was establish'd, a Cypher was added to each Remainder, *&c.* The like of all others.

IN *Reduction* of *Vulgar Fractions* to *Decimals*, if the Numerator be a single Digit, and the Denominator 9, the said Digit will continually repeat in the Quotient.

EXAMPLE III.

LET it be requir'd, to reduce $\frac{2}{9}$ and $\frac{5}{9}$ to their Equivalent in Decimal Expressions.

Operation 1.	*Operation* 2.
9) 2.000 (.222, &c.	9) 5.000 (.555, &c.

THIS is obvious, from the very *Notation of Numbers*: For in the First Operation, 2 is multiply'd by 10, which is equal to 10, multiply'd by 2, (*Euclid*, *lib.* 7. *Prop.* 16.) which Product is now to be divided by 9; but 9 is less than 10, by an Unit; and consequently, 9, multiply'd by 2, will be less by two Units, than 10 multiply'd by 2:

The

The Remainder therefore, will be 2, at every Operation, and equal to the Numerator at firſt, &c.

WHEN a ſingle Digit thus repeats in the Quotient, it is call'd a *Single Repetend*, or *Circulate*, and is diſtinguiſh'd with a Daſh croſs it, *viz.* 7̸, 8̸, &c. thereby ſaving the trouble of inſerting any more than One, or ſuch a Number of them, as in every *Operation*, ſhall be found convenient.

FROM the ſame Principle, it is evident, that any Series of Digits, &c. having ſo many 9s for the Denominator, as are the ſaid Number of *Digits*, &c. the ſame *Fraction* reduc'd to a *Decimal*, will always give the ſame *Digits*, &c. continually repeating (or circulating) in the Quotient.

EXAMPLE IV.

$$\left.\frac{148}{999}\right\} \quad 999\ )\ 148.000\ (\ .148$$

$$\begin{array}{l} 4810 \\ 8140 \\ (148) \end{array}$$

HERE, the Remainder, as well as the Quote, is equal to the Firſt Dividend; and conſequently, proceeding on in the Diviſion, it will continually be ſo: For 148 into 1000, will always exceed 148, into 999, by 148 Units; the Difference between 1000, and 999, being Unity. From whence it may be very eaſily deduc'd, that whenever any *Decimal Fraction* circulates, or repeats, &c. ſo many 9 s as are the ſaid repeating Places in the *Fraction*, will ever be the Denominator thereto. As in the Example above; the Quote consisting of 3 figures viz. .148, will have 3, 9s for the Denominator, and is a Novenal Fraction.

THESE

THESE Circulates, when they conſiſt of more than a ſingle Digit, or Place, are call'd *Compound Repetends*, and have always the Firſt and Laſt daſh'd, to diſtinguiſh them as ſuch.

FOR a Series of .9s continually circulating and decreaſing, in manner aforeſaid, there is always ſubſtituted Unity, or One.

THE Demonſtration hereof may eaſily be obtain'd, from the following known Rule in Arithmetic, *viz.*

IN a Series of *Terms*, in a continu'd Proportion, multiply the greater Extreme by the *Ratio*; and from the Product ſubtract the leſſer Extreme; the Difference divided by the *Ratio*, leſs Unity, gives the Sum of all the Series.

THUS, in a Series of .9s deſcending, in the above *Ratio*, it will be .9, .09, .009, .0009, &c. till at laſt it will terminate in 0; that is, between .9 and 0. There are an infinite (or, if not allow'd that Expreſſion) an indefinite, indeterminate, or unaſſignable Number of ſuch Terms.

THEREFORE, as the leaſt Extreme is here 0, the above Rule of finding the Sum is reduc'd to this, *viz.*

THE Greater Extreme multiply'd by the *Ratio*, and that *Product* divided by the ſaid *Ratio*, leſs Unity, gives the Sum of all the Series.

IN

In the present Example, .9 being multiply'd by 10, the *Ratio*, it becomes 9, Integral; which divided by the *Ratio*, less Unity, *viz.* 9, gives Unity, or One, equal to the Sum of all the Series, *&c.*

By the same Method may the Truth of all the other Circulates be prov'd, *viz.*

.2 .02 .002, &c. equal to $\frac{2}{9}$, as at first.
.148 .000148, &c. *ditto* to $\frac{148}{999}$

In the last Case, 1000 is the *Ratio*; by which, if .148 be multiply'd, it becomes 148, Integral; which being divided by 999, the *Ratio*, less Unity, gives the Sum, as above. The like of all others.

By which it is also demonstrated, that if a single Digit circulates, 9 is the Denominator thereto; and, in general, so many Places as the circulating *Factor* consists of, so many 9s will ever be the Denominator thereto.

Any one of the Digits, or Places of a compound Repetend may be made the First thereof; so .148 may be made .1481, or .14814, &c. In the First, the Repetend begins at 4, in the Second at 8: But care is to be taken, that the same Number of Places, from where they are thus made to begin, be also made to circulate, as at first, and to distinguish them, by dashing the First and the Last, *&c.*

Repetends, beginning at the same Place (which they may always be made to do, *per* the Last) whether at Primes, Seconds, *&c.* and ending at the same Place, *viz.* Primes, Seconds, *&c.* are call'd *Conterminous*. Consequently, Repetends, contain-

ing

ing an equal Number of circulating Places, are Conterminous.

*And any two, or more Repetends may also be made to end together, and so become Conterminous, if they are continu'd on to so many Places, that with the Place where they begin together, the Number of 'em so continu'd, be the least Common Multiple of the Numbers, expressing the Number of Places in every respective Repetend.

*Explained in Page 61. Rule

Before I proceed any farther, it may be necessary, to lay down the Method of finding such least Common Multiples.

First, There must be obtain'd, by common Rules, the greatest Common Measure to two of the Numbers, *viz.*

Divide the greater Number by the lesser; and if nothing remains, that lesser Number is the greatest Common Measure requir'd. But if there be a Remainder, divide the last Divisor by that Remainder; and if there be still a Remainder, divide the last Divisor by the last Remainder; and so proceed on, till you come to a Division without a Remainder; and then this last Divisor will be the greatest Common Measure requir'd.

EXAMPLE I.

WHAT is the greatest Common Measure to 612, and 540?

```
540 ) 612 ( 1
       72 ) 540 ) 7
              36 ) 72 ( 2
```

HERE 36 is the greatest Common Measure requir'd.

EXAMPLE II.

WHAT is the greatest Common Measure to 643536, and 4500?

```
4500 ) 643536 ( 143
          19353
           13536
            36 ) 4500 ( 125
                   90
                   180
                   (0)
```

~~EXAMPLE III.~~

Answer, 36, the greatest Common Measure the same as in the preceding.

EXAMPLE III.

WHAT is the greatest Common Measure to 13 and 45?

13) 45 (3
6) 13 (2
1) 6 (6
(0)

HERE, the last Divisor, when 0 remains, is Unity; the greatest Common Measure therefore is Unity: In which Case, the Numbers at first are always said to be Prime to each other.

DEFINITION.

A Number is said, to be a * Multiple of another, a greater of a lesser, when the lesser measures the greater, *viz.* when the greater being divided by the lesser, leaves no Remainder; which lesser Number is call'd an *Aliquot Part* of the Greater.

* *Euclid, lib.* 7. *Def.* 5.

IN which Case, *Euclid* does not consider Unity as a Number, as is plain from *Lib.* 7. *Def.* 2. viz.

Number is a Multitude, compos'd of Units.

TWO, or more Numbers being given, to find a Common Multiple to them.

RULE.

MULTIPLY all the Numbers continually, and the Product will be the Multiple sought.

EXAMPLE I.

WHAT is a Common Multiple to 3, 5, 6, 9?

$$\begin{array}{r} 3 \\ 5 \\ \hline 15 \\ 6 \\ \hline 90 \\ 9 \\ \hline 810 \end{array}$$ *Answer.*

TWO Numbers being given, to find their least Common Multiple.

RULE.

FIRST, Find the greatest Common Measure; then divide either of those Numbers by that Measure, and multiply the Quotient by the other, or the other by the Quotient; and the Product will be the least Common Multiple sought.

EXAMPLE II.

WHAT is the least Common Multiple of 24 and 32?

THI

The greatest Common Measure to the said Numbers, by the Foregoing will be found to be 8; either of which Numbers being divided thereby, and the other multiply'd by the Quotient, gives 96, the least Common Multiple sought, *viz.* which can be divided by 24, and 32, and leave no Remainder.

EXAMPLE III.

What is the least Common Multiple of 13 and 45?

The greatest Common Measure to these Numbers, was found to be * Unity; by which, dividing either of the others (as Unity, in multiplying and dividing, gives still the same Number, *&c.*) It follows, that the least Common Multiple to two Numbers, prime to each other, is their Product, and in this Example, 585, for Answer.

* *Vide* Ex. 3.

Two, or more Numbers being given, to find their least Common Multiple.

RULE.

First, Find the least Common Multiple to Two of them; and then to this Multiple so found, and the Third Number, find also the least Common Multiple: and then to this last Multiple, and the Fourth Number prepos'd, find likewise the least Common Multiple; and so on, with the *5th*, *6th*, &c. given Numbers, till the last is thus operated with. The Multiple thus found, will be that requir'd.

EX-

EXAMPLE IV.

WHAT is the least Multiple of 8, 12, 9, 15?

8) 12 (1   9) 24 (2
4) 8 (2   6) 9 (1
(0)   3) 6 (2
4) 12 (3   (0)
8

Least Cᵐ. Mult. 24 of 8 and 12   3) 24 (8 (9

Least Common Multiple } 72 of 8, 12 *and* 9

15) 72 (4
12) 15 (1
3) 12 (4
(0)
3) 72 (24
15

Least Common Multiple of all 360

IF either of the Numbers propos'd, be an *Aliquot Part* of either of the others, that *Aliquot Part* may be omitted in the Operations.

EX-

EXAMPLE V.

WHAT is the least Common Multiple to 3, 4, 6, 8, 12, 9?

HERE 3 is an *Aliquot Part*, either of 6, 12, or 9 and 4 of 8 or 12, and 6 of 12: Therefore 3, 4, and 6, may be omitted, and the least Multiple to 8, 9, and 12, found, as before, will be 72, for Answer.

IF the least Common Multiple found to the preceding Numbers, be also a Multiple to some of the following, such following Numbers may be neglected, or omitted in the Operation.

THIS is plain, from the last: For every Number must, as before observ'd, be an *Aliquot Part* of its Multiple.

THE Operations of these Examples may be perform'd otherwise. Thus,

IF the Second be compos'd to the First, divide the Second by their greatest Common Measure, and cancel it, and place the Quote under it. If the Third be compos'd to either, or both of the preceding uncancell'd×Numbers, divide it by their greatest Common Measure, continually placing the Quotes beneath it, and cancel it, and all its Quotes, except the last; and so, if the Fourth be compos'd to any, or all the preceding uncancell'd Numbers, divide it by their greatest Common Measures, continually, placing the Quotes beneath it, under each other, and cancelling it, and all its Quotes, except the last; proceeding, till you have us'd all the Numbers propos'd,

×The first Quote considered as an uncancell'd Number.

pos'd, in the said manner. Then, the Product made by the continual Multiplication of all the uncancell'd Numbers, is the least Common Multiple sought.

In this Method likewise, the Numbers that are *Aliquot Parts* of others, may be omitted. *Vide* the *following Operations.*

OPERATION I.

* 3 being an aliquot part of 9, is omitted. 9 being composed to 6, divide it by their greatest common ~~measure~~ 3, set under it, & cancel the 9.

3, 5, 6, ~~9~~ *
3
6
—
18
5
—
90 * Answer.

* *Vide* Ex. 1.

OPERATION II.

* To cancell the 9 in this operation, divide it by the first Quote 3 and place the remainder under it. ~~but the [illegible] in the following Operation.~~

8, ~~12~~, ~~9~~, ~~18~~ *
3 3 5
3
—
15
3
—
45
8
—
360 Answer.

OPERA-

OPERATION III.

$\cancel{3},\ \cancel{4},\ \cancel{6},\ \cancel{8},\ \cancel{12},\ \cancel{9}.$

$3 \quad 3$

3

9

8

---

72 Answer.

The reason of this last Method, may be easily seen, from the two former Rules; and of them also, from the common Rules of Multiplication and Division.

Addition of Single Repetends.

Make them all Conterminous; that is, to end together, by producing them forward, &c. and then Add, as before; only to the last Place to the right hand, Add as many Units as there are Nines in the Sum of that Row; and that last Digit will be a Repetend.

EXAMPLE I.

LET it be requir'd, to Add $.\dot{3} + .08\dot{3} + .\dot{6}$ together; alſo, $.0002\dot{7} + .00\dot{1} + .0\dot{1}$.

Operation 1.	*Operation* 2.
$.\dot{3}33$	$.0002\dot{7}$
$.08\dot{3}$	$.00\dot{1}1\dot{1}$
$.\dot{6}66$	$.0\dot{1}11\dot{1}$
$1.08\dot{3}$	$.0125\dot{0}$

IF theſe Circulates have any Terminate Decimals (*viz.* ſuch as do not circulate) to be added with them, you muſt continue the Circulates to a Place beyond the ſaid Terminate, &c.

EXAMPLE II.

LET it be requir'd, to Add $5.86 + 2.\dot{3} + 4.\dot{7}$ together; alſo $.434 + 74.2345 + 2.\dot{6} + 5.\dot{8}$.

Operation 1.	*Operation* 2.
5.86	$.43400$
$2.\dot{3}33$	$2.\dot{6}6666$
$4.\dot{7}77$	74.23450
	$5.\dot{8}8888$
$12.97\dot{1}$	$83.2240\dot{8}$

IN the firſt Operation, a Cypher is ſuppos'd after 5.86, which in the Second is ſupply'd: Therefore every Terminate may be conſider'd as Interminate, by making a Cypher or Cyphers the Repetend.

SUB-

SUBTRACTION *of* Single REPETENDS.

PLACE, and continue, as in *Addition*; only, when the Repetend of the *Subtrahend* is greater than that of the *Minuend*, increase the Latter by 9; then subtract (carrying One to the next Place, *&c.*) and the remaining Digit will be a Repetend.

EXAMPLES.

I.	II.	III.
24.7	$7.64\dot{3}33$	12.7648
$12.\dot{2}2$	2.7646	$2.\dot{3}3333$
$12.4\dot{7}$	$4.8787\dot{3}$	$10.4314\dot{6}$

THE Reason of so many Units being added in *Addition*, as are Numbers of 9s in the last Row to the right hand, and of borrowing a 9 in *Subtraction*, is obvious, from the Proof, that 9 is always the Denominator to these Single Repetends.

vi. Pa. 48 P. 5.

ADDITION of Compound REPETENDS.

IF the Repetends to be Added, are conterminous; that is, consist of an equal Number of Places, Add as before; only, to the last right hand Place Add as many Units, as there are Tens in the Sum of that Row, or Column, where the Repetends all begin together; and the Digits, &c. subscrib'd to the said two Places, will be the First and Last of the Repetend. The said two Places mean the figure that is subscribed to the first Column to the right Hand; and the figure subscribed to that Column where the Repetends all begin together which in the subsequent Examples is the figure to the left.

EXAMPLE.

LET it be requir'd, to Add .27 + .48 together; also .27 + .84 + .77.

Operation 1.	*Operation* 2.
.27	.77
.48	.84
	.77
.75 *Sum.*	1.08
	1 *to be added by the Rule.*
	1.09 *true Sum.*

THE First Operation is obvious; the Second, (before the Addition of the Unit, according to the *Rule*) is really $\frac{108}{99}$, *viz.* 108 to be divided by 99: But, by pointing off the two Places, as at first, it is thereby divided by * 100; which is making the Sum too little, by one 99*th* Part of the Number of Tens; the two last Places to the right hand, *viz.* .08, *per Operation* 1. (which is very

* Notat. Ex. 3. Consf. 3.

very plain) will be two Circulates: Therefore, the 99*th* Part of the Number of *Tens*, &c. which is here 1, will (by what has been already prov'd) be the Circulating Expression, 01, which added to the Sum first found, gives the true Sum requir'd, and is a Proof of the *Rule*. The like of all others.

Other EXAMPLES.

I.	II.	III.
8.5038	43.764	7.85437
2.9417	21.450	16.04321
11.5358	65.221	24.49754

****

To Add a Compound Repetend *to a* Terminate Decimal.

RULE.

TO the said Terminate, add so many Cyphers as the Repetend consists of Places: Next, continue the Repetend, equal to the Number of Places (Cyphers included) in the said Terminate; when, adding as before, gives the Sum requir'd; which will have a Repetend, equal in Number of Places, as before.

EX-

EXAMPLE I.

LET it be requir'd, to Add 12.4568 with 8.6̸46̸.

OPERATION.

12.4568000
8.6̸46̸6466
21.10344̸66̸

THE Repetend now is 4̸66̸; but in Compound Repetends, you may begin at any Place, as before observ'd, continuing the Digits in succession, equal to the Number of Places in the Repetend at first, &c.

****

To Add Circulates, *whose* Compound Repetends *consist of different Numbers of Places.*

RULE.

*v. pa. 49 FIRST, (by the Foregoing) The least Common Multiple of the Numbers expressing the Number of Places in each respective Repetend, must be obtain'd. Next, All the Repetends must be continu'd out to so many Places (that with the Place, where they all begin together) as shall be equal to the said least Common Multiple; when, adding, according to the *Rule*, gives the Sum requir'd: Which Sum will consist of a Repetend, equal in Number of Places to the said least Common Multiple, and must have the First and Last dash'd accordingly. EXAM-

EXAMPLE I.

Let it be requir'd, to Add together the following Numbers of two and three Places in the Repetends, *viz.* $3.4\cancel{1}2\cancel{7} + 2.\cancel{1}\cancel{4} + 6.5\cancel{4}\cancel{8}$.

OPERATION.

$$\begin{array}{r} 3.4\cancel{1}2\cancel{7}127 \\ 2.\cancel{1}414141 \\ 6.5\cancel{4}\cancel{8}4545 \\ \hline 12.0\cancel{0}9581\cancel{3} \end{array}$$

Here the leaſt Common Multiple to 2 and 3, the Number of Places in each reſpective Repetend is 6, Therefore they are continu'd out to ſo ſo many Places, from the ſecond Row, or Column of Decimals, *viz.* the fartheſt Place but two, to the left hand; at which Place, all the ſaid Repetends begin together.

EXAMPLE II.

Let it be requir'd, to Add together, $2,\cancel{3}45\cancel{9} + \cancel{1}.0\cancel{4} + \cancel{3}.\cancel{7}$.

OPERA-

OPERATION.

$$
\begin{array}{r}
2.\dot{8}45\dot{9}34593459 \\
1.\dot{0}4\dot{1}041041041 \\
3.\dot{7}\dot{3}7373737373 \\
\hline
7.\dot{6}2434937187\dot{4}
\end{array}
$$ *true Sum requir'd.*

In this last Example, 12 is the least Common Multiple to 2, 3, and 4, the Number of Places in each respective Repetend; equal to which, are the Number of Places continu'd, from the first Column, or Row of Decimals to the left hand, where all the Repetends begin together.

If any Terminate Decimals are at any time to be Added herewith, by making Cyphers, the Repetend thereto, and proceeding as in *Rule* 2, you cannot fail of the Sum, *&c.*

EXAMPLE III.

Let it be requir'd. to Add together $.2 + .\dot{1}\dot{8} + .\dot{1}4\dot{4}$.

OPERATION.

$$
\begin{array}{r}
.2000000 \\
.\dot{1}818181 \\
.\dot{1}441441 \\
\hline
.5\dot{2}5962\dot{3}
\end{array}
$$

Here the least Common Multiple to the Number of Places in each Repetend, *viz.* 2 and 3, is .6: The Sum of the Addition therefore will consist

conſiſt of a Repetend of Six Places: Next, the Number of Tens in the Column, or Row, where the Repetends all begin together (*viz.* the fartheſt but one to the left hand) are 1; The laſt Place to the right hand in the ſaid Sum is therefore increas'd by 1; and the Sum and Repetend are, as in the Example.

The above Fractions, expreſs'd vulgarly, are, $\frac{2}{18}$ $\frac{18}{90}$ $\frac{144}{999}$; which reduc'd and Added together by the Common Rules, become $\frac{3211}{6105}$, Sum of all the Fractions.

```
6105 ) 32110 ( .5259623 reduc'd to a Decimal.
         15850
          36400
           58750
            38050
             14200
              19900
               1585 Same as the ſecond Re-
```

mainder, which gave 2 in the Quotient. Wherefore it will again repeat, as daſh'd above, and which is equal to the Sum, according to the *Rule*, &c.

In *Example* II. the Number of Decimal Places in the Sum (the Repetend being compleated, according to the *Rule*) are 12: But generally, five or ſix Places, at moſt, will be found ſufficient: So, .124349 may be taken for Uſe; which is a very ſmall matter (almoſt inſignificant) too little. Or, ſeeing the laſt Digit to the right hand is 9, the preceding Digit, *viz.* 4, may be made 5; and then .12435, in moſt Caſes, may be us'd in lieu thereof, without any regardable Error. This being obſerv'd, Approximates may alſo be made Terminates, &c.

SUBTRACTION *of* DECIMALS, *with* Compound Repetends, *&c.*

PRepare, as in *Addition* : Next, see if you must borrow One, in subtracting, from the Place where both Repetends begin : For then the last right hand Place of the Remainder will by that means be a Unit less than otherwise it would be. The reason of this is plain, it being the Converse of *Addition*, &c. The Repetend, in the Answer, will be as in *Addition*.

EXAMPLES.

$31.\cancel{7}12\cancel{8}7$	$48.\cancel{7}3\cancel{7}7327$	$13.9\cancel{7}7896\cancel{0}$
$8\ 4\cancel{7}\cancel{7}72$	$1.5\cancel{1}\cancel{7}1717$	$8.\cancel{7}6\cancel{4}7647$
$23.2\cancel{3}\cancel{0}8\cancel{4}$	$47.2\cancel{1}5561\cancel{0}$	$5.2\cancel{1}\cancel{8}1313$

$78.5\cancel{7}22$	$48.76\cancel{5}2000$
$3.\cancel{7}6\cancel{4}7$	$23.85\cancel{4}8548$
$74.7\cancel{8}7\cancel{4}$	$24.9103\cancel{4}5\cancel{1}$

MUL-

MULTIPLICATION *with* Single Repetends.

CASE I.

IF the Multiplicand has a Single Repetend, and the Multiplier be Terminate, multiply by each Digit of the Multiplier, adding to the Product made by each Digit, and the said Single Repetend, so many Units as there are 9s contain'd therein; the remaining Digit, &c. over and above the Carriage will be a Repetend. in that Product

NEXT, The circulating Digits in the respective Products, must be continu'd out to the last Place to the right hand of the first Product; when, adding according to the *Rule*, gives the true Product requir'd.

EXAMPLES

I.	II.	III.
48.78	31.78	48.64
.7	4	6.34
34.128	127.07	19458
		145933
		2918666
		308.4058

III
48.64
6.34
19457
145933
2918666
308.4057

K 2 WHEN

CASE II. When the Multiplicand is a Terminate Expression, and the right hand Digit of the Multiplier a Repetend, multiply as with a terminate Digit, setting the Product one Place forwarder than usual, to the left hand, supplying the right hand Place, with a Cypher; which Result being divided by 9, the Quotient (which at the last Place will contain a Single Decimal Repetend or 0) will be the true Product requir'd.

EXAMPLES

I.	II.	III.
45	8.734	1276.47
$.\dot{4}$	$3.\dot{4}$	$4.1\dot{3}$ *
9) 1800	9) 349360	425490
		127647
20.0	$3881\dot{7}$	~~500588~~ 510588
	26202	
	$30.083\dot{7}$	5276.0760

*the Multip.n by the Rep.d and division by 9 omitted.

NB In the Third Example, where the circulating Digit is $\dot{3}$, one third Part of the Multiplicand (being suppos'd a Place forwarder) is taken; for three Ninths, is equal to one Third. *The same is to be observed of the second Example of the following Case.*

CASE III.

When both the Multiplicand and Multiplier consist of a Single Repetend, then, as the Multiplicand is a Repetend, there must be so many Units, as are the 9s contain'd in the Product, added thereto. Next, as the Multiplier is also a Repetend, the said Product must be likewise divided by 9, as before, till you arrive at a Single or Compound Repetend, &c.

EX-

EXAMPLES.

I.	II. *	III.
2.3	48.754	3.47
5.6	2.13	2.4
9)1400	1625148	9)1391
155	4875444	1545679012 3
1166	97508888	6955555555 5
13.72	1040.09481	8.5012345679

* II
40.754
2.13
9)1462650
1625146
4875444
97508888
1040.09481

* The first Digit (5) is advanced a Place forward according to the Rule of multiplication, the multiplicand being a Terminate, and the right hand Digit of the Multiplier a Repetend, which is the same thing when as in the printed example the Repetend or first figure in the second line is brought a place farther back to the Right; which must always be done when, as in that Example, the first Row is not advanced a place farther to the left according to the Rule above mentioned.

In the second and third Examples, where the Repetends are Compound, the respective Products are Added, according to that *Rule* in *Addition*, &c. as to the number of Repetends

Also, in the Third Example, where divided by 9, the Circulating Unit (1) is brought down at every Step. to find the remaining circulates instead of (0): viz. the 9 in 51, is 5 times, and 6 remains, then instead of the 9 in 60, say the 9 in 61, and so on using the (1) continually till the same figure that hath been answerable to a like remainder becomes a part of the Quotient a second time. Then the first figure of that kind foregoing will be the first of the Repetend in the Quotient, and the figure preceding this last, the last figure of the Repetend. The same is to be observed in the altered example added, where tho' there is an (0) ... in the place of the other figures, a (3) is used to find the remainder, circulates.

MULTIPLICATION of DECIMALS, having Compound Repetends.

CASE I.

If the *Multiplicand* has a *Compound Repetend*, and the *Multiplier* be a Terminate Expression, multiply as usual; adding so many Units, [*Vide P.* 60. *Oper.* 2.] to the right hand Place of the Product made by each Digit, of the multiplier as there are Tens in the Product made by the said Digit, and the left hand leading Digit of the Repetend.; each of which Products will contain a Repetend, equal in Number of Places to that in the *Multiplicand*; which

which being made Conterminous, and added together, gives a Repetend alſo, of the like number of Places in the *General Product*, viz. the Sum of all the aforeſaid Products.

EXAMPLES.

I.	II.
8.7643	2184.6737
7	.05
61.3810	109.233667

III.	IV.
8.6714285	417.6323
1.19	76.45
78042857 1	20881626
8671428 57	16705303 3
867142857 1	25057959 5
	29234777277
10.3180999990	31928.007112
Which is 10.319	

When in adding up the Products into one Sum in order to find the number of 10's in the Column where all the Repetends begin together (according to which so many Units are to be added to the first Column to the right hand) you must include what units be carried from the preceding Column as in common Addition. So in Example the IV. The first Column of Repetends added up makes more than 9, but by including the Overplus to 10 in the Column to the right makes [2] it makes 10, therefore (1) according to the number of tens therein, is to be added to the first Column to the right hand and the figure immediately in the Product calls for a 2, as is there placed —

In theſe Operations, it is convenient, previous to ſetting down the firſt Digit to the right hand in every particular Product, to obſerve what the Carriage, or Number of Tens in the Product of the leading Place, or Digit to the left hand in the Repetend, are; which may then be more conveniently added to the right hand Place of the ſaid Product. Alſo in Adding up the whole, to obſerve the ſame in the Place where the Repetends all begin together (which in this Caſe is always under the leading Repetend Place of the *Multiplicand*, as in the *Fourth Example*, &c.

* upon the Multiplication of ec.

CASE II.

If the *Multiplier* be a Compound Repetend, and the *Multiplicand* a Terminate Expreſſion, multiply by each reſpective Digit, as in the common way, &c.

Next, Set the higheſt Place, or Digit to the left hand of the Product, a Place lower to the right hand under the ſaid Product, than are the Number of Places in the multiplying Repetend; and ſo many of the Places in the ſaid Product, in Order, after it, as will terminate with the laſt right hand Place of the ſaid Product, repeating it in the ſame manner under this laſt Placing; and ſo on, till the ſaid higheſt Digit or Place in the Product be carry'd to the laſt Place to the right hand in the Firſt Product; which being then added up together, this laſt Reſult will be the *true Product*, containing a Repetend of a like Number of Places with the *Multiplier*; obſerving, as in the Preceding, to add to the laſt right hand Place thereof, ſo many Units, as are the Number of Tens in that Column, where all the Repetends begin together; which, in this Caſe, will be ſo many Places from the laſt, to the right hand, incluſive, as are thoſe in the Repetend of the Multiplier.

EX-

EXAMALES.

I.	II.
25	417.64
$.\dot{7}\dot{7}$	$\dot{4}.21\dot{7}$
175	292348
50	41764
	83528
$6.7\dot{5}$	167056
6	
	$1761.1\dot{8}788$
$6.\dot{8}\dot{1}$ *true Product.*	17611
	1
	$1761.3\dot{0}40\dot{1}$ *true Prod*[uct]

In the First Example, the *Product* is divided by 100, but should have been but by 99, answering in fact to the *Multiplier*; the said 75 will therefore be a Circulate, or Repetend; and 6, which is also to be divided by 99, gives $\dot{0}\dot{6}$, a Repetend. [*Vide Addition.*] By which, the First *Product* being increas'd, gives $6.\dot{8}\dot{1}$, the *true Product*, and is a Proof of the *Rule*, &c.

EXAMPLE

EXAMPLE III.

```
    47253.375
         1.48
   ----------
   378027000
  189013500
  47253375
  ----------
  69934995..
    6993499
        6993
           6
  ----------
  70004.99990
```

That is, 70005.

CASE III.

If the Multiplier consists of Terminate Places, with a Compound Repetend, set the highest left hand Place thereof, so many Places clearly below it self, to the right hand, under the said Multiplier, [*Vide Case* 2.] as are the Number of Places in the Repetend ; and also so many more of the Places, in order after it, as will Terminate with the aforesaid Multiplier ; from which subtracting the same, the Remainder will be a new Multiplier ; by which Multiplying, and ordering the Product, according to the Number of Places at first in the Repetend, [*Vide* Examples to *Case* 2. P. 72.] gives the *True Product* requir'd. The Demonsttation of this Rule, you will find at *Division*, Example 4.

EXAMPLE I.

```
   48.76
   .1345
       1
   -----
    1344  New Multiplier.
   -----
   19504
  19504.
 14628..
 4876...
 -------
 6553344
    6553
       6
 -------
 6.559002  True Product.
```

EXAMPLE II.

```
     432.43
     23.414
        234
   --------
      23180  New Multiplier. = 23.414 - 23
    345944.
    43243..
  129729...
  86486....
 ----------
 1002372740
  10023727
    100237
      1002
        10
 ----------
 10124.97777  True Product.
```

Or if the Terminate Places in the *Multiplier* exceed those in the *Repetend*, you may multiply by the Repetend Places first; to which find the true Product, as before: Next, multiply by the Terminate Places; †which several *Products*, &c. added to the aforesaid *True Product* of the Repetends, as in other Multiplications, gives the *True Product* requir'd.

†. the products of which are to be placed successively under each other as in common Multiplication; the first figure of the terminates in the first product, being placed under the first terminate of the true product by Multiplication with the Repetends only.

EXAMPLE III.

```
 432.43
  23.47
 ------
 605 40    Product, by 14 in one Line.
   6054
     60
 ------
 61151     True Product of Repetends.
172972..
129729...
86486....
----------
10124.97711  True Product of the whole.
```

CASE IV.*

*27, the Multiplier being single & Multiplicand compound!

If both the *Multiplicand* and *Multiplier* consist of *Compound Repetends*, operate as in the following Examples, which take in all the preceding Cases.

If the First *Product* contains any * Repetend, it will be equal in Number of Places to that in the *Multiplicand*, and may be continu'd out at pleasure.

* V. Ex. 1. where the Repetend vanishes.

Next, Divide the same into Periods, beginning at the left hand; each Period to contain as many Places, as does the *Repetend* of the *Multiplier*:

[*Vide Case* 2.] Then the whole First Period thereof must be added to the Second; and *this Result to the Third; and so on. But when the Sum of any Period consists of all 9s; or the preceding Period be increas'd an Unit from the said Sum‡ the last place to the right hand in the said Period † (as well as in the preceding) must also be made One more. Proceed thus, till you arrive at a Repetend, or to such a Number of Places as shall be thought proper; which will be so far the *True Product* requir'd.

*the Product thereof, to Third, and so of any fourth & Period, as in Case II ... ‡ Vide Addition pa. 60

† vi. Ex II in the First product

1 P	2 P	3 P
vg. 24	68	73
1st period 24	+32	
	32	06
	1	
24	33	06

transfered from product of 68+24=32, gives 73+32=105, and 1 to be carried to the preceding period (viz 32. Wherefore the 05+1=06; with 1 to be carried to the preceding period and placed under 2.1 77 7 makes the second period 33; & the 3d period 06; and 11.98 so of the fifth & sixth periods.

EXAMPLE I.

2.1 7̇7̇

11.98

11

New Multiplier 11187

*15200
173818
211772
2117727
21177272

243.06200

That is, 243.063

|243

243.306 *True Prod.*

In this Example (*per* Case 1.) the Repetends in each *Product* begin at the second Place from the right hand, and are made Conterminous.

In Adding up these several *Products*, when made Conterminous, the Repetends all begin together at the Second Place to the right hand, under the

the *leading Repetend* Place in the *Multiplicand*, (*per* Case 1.) as is also plain from *Addition*, the *Multiplicand* being only added up so many times to it self, as the *Multiplier* contains Unity.

Lastly, This *First Product* being (*per* Case 2.) divided into Periods, and order'd according to the Rule, the last Result, or *True Product*, will contain a *Repetend* of three Places, as in the Example, &c.

EXAMPLE II.

```
                        111.98
                         2.107
                            21
New Multiplier           2.151
                         11198
                        559909
                       1119819
                      22395396
First Prod.      2408732243243
                   243|2|06|306|2
                 24|3 2|06 3|0 6 2|0 6
                      1            1
                 243.306306306,  True Prod. as
                 [in the preceding Example.
```

EX-

EXAMPLE III.

LET it be requir'd, to multiply 3.148 by 4.2977; the new Multiplier will be found to be 4.293.

```
               3.148
               4.293
              ------
               9436
             283090
             629690
           12581818
           --------
First Prod.  13.50346363636363636
                   |135|169|532|169|532
             --------------------------
             13.5|169|532|168|532|169
                 |    |  1|  1|  1|  1
             --------------------------
True Prod.   13.5169533169533169
     Viz.    13.5169533, &c.
```

IT frequently happens, and chiefly, when the Places of the Repetends in the Factors, contain many Places, that the *Product* may be continu'd to a Multitude of Places, before it will repeat, &c. But such Mutlitude of Places, tho' Curious, are too burthensome for Use. Wherefore it may be carry'd only to such a Number, as shall at any time be judg'd convenient.

OR, if the said *First Products* in the preceding Examples be severally divided by so many 9 s as the Repetend in the *Multiplier* consists of Places, the Quotients will likewise give the *True Products*. *Vide*

Vide Example I. *Case* 4.

First Prod.

999)243.063 (243.306 *True Prod. as before.*
4326
3303
3060
6300
Remainder (306) Same as when 3 took place in the Quote.

Vide Example II. *Case* 4.

First Prod.

99) 24087.324 (243.308 *as above.* 99|24087.324|2433.06
428
327
308
624
Remainder 30 Same as when 3 took place [in the Quote.

In dividing by the 9s, &c. the Decimal Places answering to the Multiplicand only, are to be pointed off in the said First Product, &c.

By comparing the Operations of these Compound Repetends, with those of the Single, it may be easily seen, that the same Reason takes place in both; the former only involving more 9s in every Operation; and by which their whole Processes may be also clearly demonstrated.

An Example or two will clear this up.

EX-

EXAMPLE I.

Let it be requir'd, to multiply 234 by $\frac{1}{9}$; (which is dividing the ſame by 9.) *Vide* P. 45.

The Multiplicand, which is here the Product, being order'd according to *Ex.* II. *Caſe* 2. *P.* 72, will be as follows.

$$\begin{array}{r} 234 \\ 23 \\ 2 \\ \hline 25.\dot{9} \end{array}$$

That is, 26.0 [*Vide Page* 47. and *Addition of Single Repetends*, &c.]

This will be plain, from what has been already prov'd, *Page* 45, &c. For 2, the firſt Digit, being divided by 9, will be alſo the firſt Digit of the Quote, and likewiſe a Circulate; and for the ſame reaſon, 3 will be the next Digit to be in the Quote, and a Circulate alſo; which, with the aforeſaid 2, that circulated, gives 5 for the ſecond true Digit of the Quote; and the ſaid 5 (3 and 2 both circulating) is now to be added to the laſt Digit 4; which, for the aforeſaid reaſon, being likewiſe a Circulate, gives 9, a Circulate, as above, &c.

From Pages 45, 46, and the above way of reaſoning, the Demonſtrations to all the foregoing Rules evidently appear.

From

FROM the above Proof may also be seen, that when any Series of Digits are to be divided by 9, how the Quotient may more easily and expeditiously be obtain'd by *Addition*.

RULE.

BEGIN at the last Place to the right hand, and Add up the Digits in the Series, first drawing a Line under them, as in *Addition*; and to the Sum Add as many Units as there are 9 s therein: Set down the Remainder, over and above the Carriage, a Place below the last Place, to the right hand of the Series, to be Added, &c. which will be a Cypher, or a circulating Decimal: Next, leaving out the last right hand Place in the said first Series, Add the Carriage to the Digit next preceding it, proceeding on, as at first; which Sum, as before, must be set down to the left hand of the last: Next, the two last Places to the right hand of the said first Series must be omitted, and the Carriage carry'd to the next preceding them, and so on, omitting a Place each time, till all are thus operated with, which will give the true Quotient requir'd.

EXAMPLES of this may be made at pleasure.

THE Proof of this Rule will be obvious, by beginning at the Top of each Row, in the preceding Example, and Adding downwards.

BY this Rule also, *Example* 3, p. 69, will become vastly easy, where the Product is divided by 9.

THE Examples, with Terminates and Single Repetends, may be operated in the ſame manner as the Compound.

From Example II. *Page* 68.

8.734
3.4
3
—————
31 *New Multiplier.*
—————
8734
26202
—————
270754 *Firſt Product.*
27075
2707
270 } *per* Caſe II.
27
2
—————
300837 *True Product.*

OR, if this firſt Product, as before obſerv'd, had been divided by 9, it would have given the True Product, as under.

BY this Example alſo, 'tis very conſpicuous that the farthermoſt Row to the right hand, beginning at the Top, contains the Digits and Places in order in the Firſt Product; the next preceding Row the ſame, beginning at the ſame Place, and ſo on: By which, the ſaid Product may more eaſily be obtain'd, *per Addition*, as before, without ſetting down any more Digits, &c. than in the firſt Product.

From

From Example III. P. 69.

3.47
2.4
2
———
22 *New Multiplier.*
———
698
6985
———
7651
———
8.5ø12345679ø

THE Circulating 1 being continually added to the laſt Product, gives the True.

WHEN it came to 8, as the next Place would have been a Circulating ø, the ſaid 8 is therefore made 9, and the ſucceeding Place a 0; which being the ſame at the *9th* preceding Place, the Circulation of the Product is there compleated, and the Firſt and Laſt daſh'd accordingly.

BY all which, it is obvious, that the Principles on which the Operations of the Single Repetends depend, are the ſame with the Compound, as before obſerv'd.

DIVISION *of* DECIMALS, *with* Repetends, *&c.*

IF the Dividend contains a Repetend, and the Divisor be a Terminate Expression, the said Repetend is to be continu'd, as necessary, and each respective Figure brought down to the Remainder in the Division, [*Vide* P. 69. *Ex* 3.] proceeding till you arrive at a Repetend, *&c.*

EXAMPLES

I.	II.
$8\ )\ 45.3\cancel{6}\ (\ 5.6708\cancel{3}$	$12\ )\ 72.\cancel{1}4\cancel{4}\ (\ 6.\cancel{0}1\cancel{2}$
53	$\cancel{1}\cancel{4}$
$5\cancel{6}$	$2\cancel{4}$
$\cancel{6}\cancel{6}$	(0)
$2\cancel{6}$	
(2)	

INSTEAD of continuing out the Repetend in the Dividend, by dashing each Digit, or Place, that you take down to each Remainder, the next in order, for that use, will be seen by Inspection: Also observe, if the like Remainder has happen'd before in the Process, the Digit, or Place answering thereto in the Quotient will be the First of the Repetend; and that answering to the Remainder immediately preceding the same Remainder again, the Last. [*Vide* Page 52, &c.]

EX-

EXAMPLE III.

```
14 ) 72.147 ( 51.53010
      21          14
       74        ————
       47     20812040
       14     51530101
Same Remainder, 71  ———— ————
as at the 2d Step,    72.147142 Dividend.
answering to 1 in
the Quote.
```

To carry on the Division in this Example instead of bringing down the last Digit to the right hand Dividend which in Division of single Repetends is the only repeating Digit. Take the first of the compound Repetend and the following to the right hand in succession, till they have all been used. Beginning again with the first figure in the Repetend and so continuing with the others in the same order as often as may be necessary, till the last figure of the Repetend in the Quotient is discovered as distinguished in the Directions following the first and second Example of this Section —

HERE, after the Products by 14, are made Conterminous, there is an Unit added for the 10, in the Place where all the Repetends begin together, *viz.* the Sixth Place from the last right hand Place inclusive. The like of all others.

LEMMA,

IT is evident, that if any Number be multiply'd by 10 (which is, adding a Cypher thereto,) and from this Product, the same Number be subtracted, the Remainder will contain 9 times the said Number, *viz.* is equal to the *Product* of the said Number into 9: Or, if every Number be to be multiply'd by 100, (which is adding two Cyphers thereto) and the said First Number be subtracted from this *Product*, there will remain 99 times the said Number; and so on.

THIS is just the Converse to finding the Decimal Expression of a Number, or *Fraction*, whose Denominator is 9 or 9s, *&c.* [*Vide* Page 45.] and by which it was meant, that it might easily be deduc'd, that 9, or 9s, *&c.* was always the Denominator to such *Fractions.* EX-

EXAMPLE.

Notat. Ex. 3. Conf. 6.

$.\dot{2}\dot{2}$ multiply'd by 10, becomes $2.\dot{2}$ *.
From which ſubtracting $.\dot{2}$

There remains —— —— 2, *viz.* 9 times the firſt Number.

Therefore, the ſame being divided by 9, will be thus expreſs'd, $\frac{2}{9}$, equal to the *Vulgar Fraction* at firſt, &c.

Again,

$.\dot{2}\dot{7}\dot{2}\dot{7}$ &c. multiply'd by 100, becomes $27.\dot{2}\dot{7}$, *as above.*
From which ſubtracting —— $.\dot{2}\dot{7}$ &c.

There remains —— —— 27 .. 99 times [the ſaid firſt Number.

Which being divided by 99, gives $\frac{27}{99}$, *Fraction at* [*firſt*, &c.

By this may alſo be very eaſily ſeen, the truth of ſumming up the Infinite, or Indefinite Series, &c.

Example *in the* Series *of* .9 s,

Viz. .99, &c. becomes 9.9, &c.
From which ſubtracting .9, &c.

Remains —— —— 9.0 *viz.* 9 times [the firſt Number, or Quantity.

Which therefore being divided by 9, gives Unity, the firſt Number, or Quantity; of which, all the Following were Parts, &c.

This

This being premis'd, I proceed to the Division of *Decimals*, whose Divisors contain a Repetend, or Repetends.

EXAMPLE I.

Let it be requir'd, to divide 7, an Integral, by .5̇, a Circulate.

Here .5̇ is really $\frac{5}{9}$, or 5 divided by 9; which, to be made Integral, must be multiply'd by 9; but to maintain the same *Ratio*, the Dividend must also be multiply'd by 9; and so the New Divisor and Dividend will be 5 and 63: But by the Preceding, it has been shewn, that multiplying any Number by 10, *&c.* and from this *Product* subtracting the said Number, the Remainder will be the said Number multiply'd by 9, &c. [*Vide* the following Example.]

Divis. *Div^d*.

5 .5̇) 7 (
    .5̇   7

5) 63 (12.6 *True Quote*.
13
30
(0)

The Cypher to the 7 in the Dividend, *&c.* (*viz.* when multiply'd by 10) is understood. [*Vide Lemma.*]

If this last Divisor and Dividend be now divided by 10, it will become as under, *viz.*

.5) 6.3 (12.6 *True Quotient*, *as before*.

By

By which may be ſeen, that making the Place, made by the Subtraction of the mov'd Dividend, a Decimal, the Diviſor is thereby depriv'd of its Circulation; and the Operation becomes as in Terminates, &c.

EXAMPLE II.

Let it be requir'd, to divide 45, Integral, by ·45, a Circulate.

```
·45 ) 45
       45
  ___ ___ ___
·45 ) 44·55 ( 99  True Quote.
       405
      (000)
```

The Reaſon for moving the Dividend two Places to the right hand of it ſelf, before Subtraction, is obvious, from the Principle of the preceding, and the latter Part of the *Lemma*; which gives this Rule, *viz.*

When any Number is to be divided by a Repetend, or Circulate Expreſſion, ſet the whole Dividend under it ſelf, in ſuch manner, that there may be ſo many Places beyond the laſt right hand Place thereof, as are thoſe in the ſaid Repetend: If the Dividend be Terminate, imagine Cyphers, and ſubtract; which Remainder will be the New Dividend: Obſerving, that the ſame will now be increas'd ſo many Decimal Places, as remov'd to to the right hand.

If the Dividend at first contains a Repetend, instead of supposing Cyphers, continue the same out so many Places as remov'd; when subtracting and dividing, as *per* former Rules, gives the true Quotient requir'd.

EXAMPLE III.

Let it be requir'd, to divide 70005 by 1.48.

```
        70005
           70005
        ──────────
1.48 ) 69934.995 ( 47253.375
        1073
          374
           789
            499
             555
             1110
               740
             (000)
```

If the Divisor be both a Terminate and Repetend Expression, order the Dividend by the Rule preceding.

Next, The Divisor must be order'd, as before of the Multiplier. [*Vide* Case 4. p. 73.] When, dividing likewise, as *per* former Rules, gives the true Quotient requir'd.

N EX-

EXAMPLE IV.

LET it be requir'd, to divide $243.\dot{3}0\dot{6}$ by $2.1\dot{7}\dot{7}$.

$$
\begin{array}{lll}
2.1\dot{7}\dot{7}\ ) & 243.\dot{3}0\dot{6}30 & \\
21 & \quad 243\dot{3}06 & \\
\hline
2.151\ ) & 240.87\dot{3}2\dot{4} & (11\dot{1}.98 \\
 & 2577 & \\
 & \quad 426\dot{3} & \\
 & \quad 2112\dot{7} & \\
 & \qquad 1763\dot{4} & \\
\textit{Remainder} & \qquad 426 &
\end{array}
$$

Same as at 1 in the [Quote, where the first *Repetend Digit* was.

IN this Example may be obſerv'd, that in ſubtracting the remov'd Dividend, the Place where the ſaid Repetends begin together is the Third Place from the laſt right hand Place incluſive: The new Dividend will therefore conſiſt of a Repetend of the like Number of Places, &c.

THE reaſon of ordering the Diviſor in the aforeſaid manner, is, that the whole Diviſor may have 99 for the Denominator, as well as $\dot{7}\dot{7}$, the Repetend Part. Suppoſe the Diviſor to be multiply'd by Unity, with ſo many Cyphers as are the Number of Places, in the Repetend, which in this Example is 100, and the Product $217.\dot{7}\dot{7}$; from which ſubtracting the aboveſaid firſt Diviſor, the Remainder will be 215.1, *viz.* 99 times the ſame. *V. Lem.* &c. Wherefore, the *Diviſor* thus order'd, will have 99 for the Denominator; anſwering to which the Dividend is mov'd two Places below it ſelf, and ſubtracted; by which means the Dividend has 99 alſo for its Denominator; both which Denominators being now rejected, the remaining Numbers will retain the ſame *Ratio* (*Euc l.* 7. *Pr.* 17.) when dividing *per* Rule, &c. gives the *true Quote* requir'd.

IT is likewiſe to be obſerv'd, that as the Diviſor was

was multiply'd by 100, the Decimal Point, by that means, was remov'd two Places lower to the right hand; the like of the *Dividend.* [*Vide* Ex.2. *Caſe* 5. p.79.] But as *per* the *Converſe* to the foreſaid *Prop.* if the laſt prepar'd Numbers be again divided by 100, the ſame *Ratio* will ſtill ſubſiſt, and the *true Quotient* had, as before; that Part of the *Operation* is therefore omitted. [*Vide* latter Part to *Ex.* 1. p.87, and 88.] It is likewiſe obſervable, that by moving the Diviſor ſo many Places below it ſelf, as are the Number of Places in the Repetend, the Repetend vaniſhes; as they will alſo in the Dividend, when equal in Places to thoſe in the Diviſor. [*Per* this, the Demonſtration to *Caſe* 4, p. 73, of *Multiplication*, is plainly ſeen.]

EXAMPLE V.

```
.0317 ) 395.273014, &c.
    0     395273, &c.
        ---------------
.0317 ) 394.87834 10, &c. (12456.73 Quote.
         778                .0317  Diviſ.1.
          1447             ---------
           1798          21176441  per 17 in
            2133         3737019   (one Line.
             2314        -------- ----
               951       394878341
              (...)        394878
                              394
                             ----
                         395.273014 Firſt Di-
                                    (vidend, &c.
```

EXAMPLE VI.

```
417.837 ) 70933.64336
    417 )     7093364
-------   -----------
417.215 ) 70862.70977 ( 169.84
            29141 20
             4108 309
              353 3747
               19 60277
                291412   Same as when 6
                        [took place in the Quote.
```

In *Example* 5, the Repetends, by removing the Dividend, *&c.* vanish.

If before the Quotient repeats, it should require a tedious Operation, you may leave off at what Number of Places may be found proper or convenient, *&c.*

Reduction *of* ASTRONOMICAL, *or* Sexagesimal Numbers *to* Decimal Expressions, *and the contrary.*

In this Case, you are to consider, how many of the Denomination of the Number to be reduc'd, make one of the next superiour Denomination *: For that will always be the Denominator thereto; which plac'd under the Number to be reduc'd, as in *Page* 43, gives the Vulgar Expression thereof: When, proceeding according to the Rules there laid down, *&c.* you will have the Decimal Expression requir'd.

* *Vide* Page 2.

EXAMPLE

EXAMPLE I.

LET it be requir'd, to reduce 47″ to a Decimal Expression, *viz.* $\frac{47}{60}$ of a Minute, Vulgarly; which being order'd for Operation, will be as under. [*Vide Notat. Ex.* 3. *Consec.* 3. and the *Converse Rule*, p. 34.

6) 47 (.783 *Decim. Expression requir'd.*
50
20
(2)

BUT if it be requir'd, to know the Decimal Expressing, what part of a Degree the said 47″ is; as 60′ make a Degree, [*vide* Page 2.] the said 47″, *viz.* the Decimal Answering thereto, must again be divided by 60.

EXAMPLE II.

6) .0783 (.01308 *Decimal Expression requir'd.*

Which you will find in the *Table*, titled, *Seconds of a Degree*; and by which Method the said Table was constructed.

IF it be requir'd, to find the Decimal Expression for 47′; as 60′ are equal to a Degree, the next superiour Denomination, the aforesaid .783 will be the Expression requir'd; and by this Method was the *Table*, titled, *Minutes of a Degree*, constructed. Both which Sums added together, as follows, will be the Expression of 47′ 47″.

EXAMPLE III.

.01305
.78333

79638 *Decimal Expression requir'd.*

BY

By this Method, may the Decimal Expreſſion of Minutes and Seconds be at any time obtain'd from the Tables.

Or, having found the firſt Decimal Expreſſion of 47″, *viz.* .783, by prefixing thereto the 47′, and dividing by the Rule, you will likewiſe have the Decimal Expreſſion of Both.

EXAMPLE IV.

6) 4.7783 (.79638 *as before.*
57
38
23
53

Let it be requir'd, to find the Decimal Expreſſion of 1′, 0″, 40‴ of a Degree, *viz.* ſuppoſing a Degree to be the Integer.

When the Parts of the Integer, as in this Example are of different Denominations, the beſt way will be, to place them in the following Order, dividing according to the Rule; and placing the Quotes immediately to the right hand of the next ſuperiour Denomination.

EXAMPLE V.

6	4.0
6	.06
6	.101
	.016851 *Decimal Expreſſion requir'd.*

In the ſecond Place, where the Seconds were Nothing, a Cypher was there plac'd, which was afterwards pointed off to the right hand, as dividing by 6, inſtead of 60, &c.

EX-

EXAMPLE VI.

Lastly, Let it be requir'd, to find the Decimal Expression to 4 S. 9° 23′ 3″ 30‴.

HERE it is to be observ'd, that the whole Circle, or 12 Signs is now the Integer, and the Question, what is the Decimal Expression of the aforesaid Part thereof?

6	3.0
6	.35
6	2.30583
3	.93843055
12	4.312810185
	.35940084876543209 *Decim. requir'd.*

IN the Fourth Step, it is divided by 3, which, indeed, is by 30; because 30 Degrees make a Sign: But the 9 was pointed off; which is dividing that Expression by 10; and consequently, 3 is the Quotient of 30, divided by 10, &c. [*Vide* the Converse Rule, *p.* 34.

IN the last Result, tho' continu'd to so many Places, the first Four will be found sufficient for Use: Or, seeing that 8, which succeeds immediately the two Cyphers following the first four Places, is considerably above 5, an Unit may be substituted for it in the next preceding Place; and this may be done at any time discretionally, according to the Accuracy requir'd, when the Quotients, &c. flow on to many Places.

THE Rules apply'd in finding the Decimal Expressions to these *Sexagesimal Numbers*, are universal to all others, having due regard to the Direction first laid down, *viz.* How many of the De-

Denomination to be reduc'd, make One of the next Superiour, &c.

Any Decimal Expression being given; also the Denomination of the Integer it respects; To find the Value thereof in the next inferiour Denomination, &c.

THIS is the Converse of the former: For having consider'd, how many of the next inferiour Denomination make (or are equal to) the Integer the said Decimal Expression respects, multiply the said Decimal Expression thereby; when pointing off so many Places in the Product for Decimals, according to the Rules before laid down, the Remaining to the left hand will be the Answer requir'd.

EXAMPLE I.

LET it be requir'd to find the Value of .783, of a Minute.

HERE the next lower Denomination to Minutes, are Seconds, 60 of which are equal to one Minute. Multiply .783 therefore by 60, and the Product will be the Answer. As in *Division*, the Numbers to be divided by 60, were previously divided by 10, and then by 6; so, conversly, they may in these Cases be multiply'd by 10, and then by 6; which is, pointing off a Place to the left hand, or conceiving it to be so; and then multiplying by 6, which gives the Answer requir'd. Or otherwise, by pointing off a Place less in the Product for Decimals; all which is very obvious.

OPE-

OPERATION.

$$\begin{array}{r} 7.83 \\ 6 \\ \hline 47.00 \end{array}$$

47.00 *Answer requir'd*, viz. 47'.

EXAMPLE II.

LET it be requir'd, to find the Value of .3594008487654320∅ of a Circle, (*viz.* the Circle being the Integer) in Signs, Degrees, Minutes, &c.

HERE the next inferiour Denomination is Signs, of which 12 make the Circle, or Integer; by which multiplying according to the Rule, and so on, you will have the Answer requir'd; which you will find to be the Converse of the Preceding, &c.

AND here it may be observ'd, that making use of 3594008, will be found accurate enough, thereby leaving out the Repetend of 9 Places. *Vide* Example.

0 .3594008

```
     .35940085
            12
S.  ----------
     4.3128102
             3
°   ----------
     9.384306
            6
'   ----------
    23.05836
           6
"   ----------
     9.5016
          6
'"  ----------
    30.096
```

In the Product *per* 12, the 0, as being of no Value at the End of a Decimal Expression, is omitted; as is also that after 3, in the next Operation, and a Place less pointed off in the Product made thereby. The same in the following Products is also observ'd.

In the Product by 12, the Decimals being pointed off, the Integral Part to the left hand are Signs, and the Expression so pointed off, the Decimal Parts of a Sign; which, as 30 Deg. are equal to a Sign, is therefore multiply'd thereby, &c. The like Reasoning takes place in the other Products.

From the *6th* Example of the last, it may be observ'd, that notwithstanding 9 Places to the right hand in the exact Decimal Expression are curtail'd; yet the true Answer, even in Thirds, is brought forth, the Expression beyond that

being

being in this caſe of no conſideration at all. By which, a Perſon, with a little reflection, may at any time abridge ſuch Multiplicity of Places, without any ſenſible Loſs: For in ſome Caſes, .3594 will be ſufficient; or 359401, &c. and this at diſcretion, according to the Accuracy requir'd, as before obſerv'd.

IF (as before) the Method of reaſoning in the Reduction of theſe Decimal Expreſſions, be carefully obſerv'd, it will be found to extend to Numbers of all Denominations whatever.

THUS, having finiſh'd the Theory of *Decimals*, I proceed to the next Subject-Matter of this Treatiſe, *viz.* the Compendious Calculation of the Places of the Luminaries; wherein the Uſes of the ſaid Decimals, both Terminate and Circulate, (which in Computation, may be deem'd Univerſal) will conſpicuouſly appear.

being in this case of no consideration at all. By which, a Person, with a little reflection, may at any time abridge such Multiplicity of Places, without any sensible Loss: For in some Cases, .5594 will be sufficient; or .559401, &c. and this at discretion, according to the Accuracy requir'd, as before observ'd.

If (as before) the Method of reasoning in the Reduction of these Decimal Expressions, be carefully observ'd, it will be found to extend to Numbers of all Denominations whatever.

Thus, having finish'd the Theory of Decimals, I proceed to the next Subject-Matter of this Treatise, *viz.* the Compendious Calculation of the Places of the Luminaries; wherein the Use of the said Decimals, both Terminate and Circulate, which in Computation, may be deem'd Universally will conveniently appear.

Of the Calculation of the Places *of the* LUMINARIES: *With the Uſes of the following* TABLES.

IT will be neceſſary, previous to the Calculation of the Sun's Place, to inſtance the Principles on which the Table of his Mean Motion and Anomaly for every Fourth or Leap-Year were conſtructed.

The Tropical Year, *viz.* from the Sun's Entrance into any Point of the Ecliptic, ſuppoſe the Equinoctial Point *Aries* (from whence the mean and true Longitudes are always reckon'd) to his next Return to the ſaid Point, is found, according to the lateſt Obſervations, to conſiſt of 365 Days, 5 Hours, $48'$, $54''$, $46'''$, $28''''$, and $25'''''$, and the Motion of the Sun's Apoge for the ſaid Time $1'\ 0''\ 40'''$. But in every common Year, there are taken into the Account 365 Days only.

By an accurate Computation, the Mean Motion or Longitude of the Sun for 365 Days will be found to be 11^s, 29°, $45'$, $40''$, $14'''$, $15''''$, $31\frac{1}{2}'''''$.

Therefore, if the Sun on any Day of the Month at Noon be in the firſt Scruple or Point of *Aries* the enſuing Year (*viz.* a common Year of 365 Days) he will on the ſame Day of the Month at Noon want $14'\ 19''\ 45'''\ 44''''\ 28\frac{1}{2}'''''$ of that ſaid Point, *viz.* the Complement of the aforeſaid Mean Motion $11^s\ 29^\circ\ 45'\ 40''\ 14'''\ 16''''\ 43'''''$ to the Circle or 360 Degrees.

The

The following Year he will want $28' \; 39'' \; 31''' \; 28'''' \; 57'''''$, *viz.* twice the ſaid Quantity, the third Year $42' \; 59'' \; 17''' \; 13'''' \; 25\frac{1}{2}'''''$, three Times, and the fourth Year $57' \; 19'' \; 2''' \; 57'''' \; 54'''''$, four Times the ſaid Quantity; which laſt being near the Motion of a Day, *Julius Cæſar* (by whoſe Account we ſtill reckon) added a Day every fourth Year to that Year, making it to conſiſt of 366 Days, and called it *Biſſextile*, from *bis* twice, and *ſextus* the ſixth; becauſe that Year the Sixth of the Calends of *March*, viz. *Feb.* 24. was twice reckon'd, making that Month to contain 29 Days, which otherwiſe is never but 28, and which Year is vulgarly called *Leap-Year.*

The Mean Motion of the Sun for one Day is $59' \; 8'' \; 19''' \; 45'''' \; 54'''''$, from which ſubtracting $57' \; 19'' \; 2''' \; 57'''' \; 54'''''$, the Quantity falling ſhort every 4th or Leap-Year, as above, the Difference will be $1' \; 49'' \; 16''' \; 48''''$. Therefore, by the Intercalation of the ſaid Day (and conſequently of its Motion) the Sun will every Biſſextile or Leap-Year, according to his Mean Motion, be advanced the ſaid Difference beyond the Equinoctial Point *Aries*, from whence he firſt ſet out, *viz.* the ſaid Equinoctial Point will be ſo much anticipated, which, in 33 Leap, or 132 Years, amounts to 23 min. 31 ſec. of Time above a Day.

Hence are deduced the following Rules, *viz.*

1. As every Fourth Year is a Leap-Year, the Number of Years between any and the next preceding or ſubſequent Leap-Year, can never exceed 3.

2.

2. Therefore, dividing the Number of Years from any aſſigned Leap-Year by 4, the Quotient gives the Number of Leap-Years therefrom; and the Remainder (if any, otherwiſe 'tis Leap-Year) the Number of Years after Leap-Year.

The Firſt Year of Chriſt being Leap-Year, dividing any Year thereof by 4, gives as above.

3. If to the Sun's Mean Place on any Day, *&c.* of your firſt aſſign'd Leap-Year, you add (in calculating forward) ſo many times 1′ 49″ 16‴, *&c.* (the Quantity the Sun every Fourth or Leap-Year advances forwards) as is the Quotient, or Number of Leap-Years therefrom, you will have his Mean Place accordingly; that is, if it be a Leap-Year: If not, you muſt deduct ſo many times 14′ 19″, *&c.* (the Quantity the Sun, every ſingle Year, or Year after Leap-Year, falls ſhort) from the Mean Place before found, as is the Remainder, or Years after Leap-Year. And thus will be obtained the Mean Place of the Sun for the Time required.

On theſe Principles the Table of the Sun's Mean Motions for Leap-Years is conſtructed; and the Radical Year I have made 1736, all the Mean Places and Anomalies being alſo calculated for every Day at Noon, in the reſpective Months of the ſaid Year.

The reſpective Anomalies likewiſe in the ſaid Table for Leap-Years, are, with its proper Numbers, conſtructed on the ſame Principles as the Sun's Mean Motions, *viz.* As the Motion or Place of the Apoge, being ſubtracted from the Mean Place or Longitude, always gives

gives the Mean Anomaly, if from the aforesaid Mean Motion of the Longitude every Leap Year, *viz.* 1′ 49″ 16‴, &c. be subtracted, 4′ 2″ 40‴, &c. the Motion of the Apoge for the same time, you will have 2′ 13″ 16‴, &c. negative, *viz.* the Mean Anomaly will every 4 Years forward decrease that Quantity; the same Method is observ'd with all the other Mean Longitudes, &c. in the said Table.

In the said Table, against Unity, or 1, as a Quotient, you have the aforesaid 1′ 49″, &c. to be added (for any Time forward) to the Radical Mean Place of the Sun; as also *2′ 13″, &c. to be subtracted from the Radical Mean Place of the Anomaly, and so on; the Numbers against each respective Quotient being such Multiples of these, as the said Quotient is of Unity.

Therefore, when the Number of Years from the *Radix* are divided by 4, against the Quotient in the said Table, you have the Numbers under the Mean Motion to be added (in calculating forward) as above-mentioned, and under the Mean Anomaly to be subtracted from the Radical Mean Places of any assigned Day of the Month, Hour, &c. in the Year 1736; which reduces the same to the Places on the said Day of the Month, Hour, &c. for the Year requir'd; that is, if, as before observ'd, it be Leap Year: Otherwise, seek the Remainder, or Years after Leap Year, at the Bottom of the Table; against which, the Numbers in both Cases (as they always must be) being † subtracted from those

* The Numbers in that Case answering likewise to 4 Years.
† *Vide* Rule 3.

those found, as above, give the Places of the *Mean Motion*, and *Anomaly* requir'd.

As, what farther is requisite to be said on this Head, will occur in Examples (which serve best to illustrate things of this nature;) I shall next proceed thereto; by which, the Ease and Conciseness of the Operations will also more evidently appear.

And here it must be observ'd, that in all Astronomical Calculations, the Day is made to begin and end at Noon; and any time between the Noon of one Day, and that of the succeeding, is call'd, so many Hours, Minutes, &c. *P. M.* viz. *post Meridiem*, or *after Noon* of the preceding Day: Or, if the Hours, &c. should extend to the Forenoon of the succeeding Day, by subtracting 'em from 24, the Remainder will be so many Hours, &c. *A. M.* viz. *ante Meridiem*, or *before Noon* of the said succeeding Day.

EXAMALE.

Let it be requir'd, to calculate the Place of the Sun, *Aug.* 4. at Noon, 1738.

In the Table of the *Radical Mean Places of the Sun*, and Anomaly for each Day at Noon, in the Year 1736, take out the Numbers answering to *Aug.* 4, viz. 4 Signs, 24 Degrees, 7 Minutes, and 40 Seconds, for the Sun's Mean Place; and 1 Sign, 15 Degr. 52 Min. and 31 Sec. for his Anomaly.

Next, to reduce this to the Time requir'd, the Number of Years from the *Radix* are but 2, and in this sense, not capable of being divided by 4; therefore come under the Denomination of Remainders, or Years from Leap-Year; against which, as such, the Numbers both for the Sun's *Mean Place* and *Anomaly*, viz. 28 Min. 39 Sec. and

30 Min. 41 Sec being, according to the Rule, subtracted from the aforesaid *Mean Places* of the Sun and *Anomaly*, give those for the time requir'd, *viz.* 4 Signs, 23 Degr. 39 Min. and 1 Sec. the Sun's *Mean Place*; and 1 Sign. 15 Degr. 21 Min. and 50 Sec. his *Anomaly*.

NEXT, To obtain the Sun's True Place for the said Time, enter the *Table of the Equation of the Sun's Centre*, with the Sun's *Mean Anomaly* thus found; and in the Column, under the Sign, and against the Degree, on the left hand side, if the Sign you enter with be found at the Head of the Table; or on the right hand side, if at the Bottom thereof, and you will have an Equation; which added to, or subtracted from the aforefound *Mean Place* of the Sun, according as the Table directs, gives his True Place requir'd, according to *Equal* or *Mean Time*.

BUT it seldom happening, that you have an exact Degree to enter the Table of the said Equation with (or indeed, any other) the Method of proportioning in such Cases is as follows.

IN the present Example, the Sun's *Anomaly* is found to be 1 Sign, 15 Degr. 21 Min. and 50 Sec. which 21 Min. 50 Sec. must be proportion'd for thus: In the *Table of the Equation of the Sun's Centre*, Against 1 Sign, 15 Degr. you have 1 Degr. 21 Min. 3 Sec. and against 1 Sign, 16 Degr. is 1 Degr. 22 Min. 28 Sec. The difference, which is increasing, is 1 Min. 25 Sec. or 85 Seconds; the 21 Min. 50 Sec. to be proportion'd for, being reduc'd to the Decimal Fraction of a Degree, or taken out of the Table, is .3638; and the Proportion, as $1^{\circ} : 85'' :: .3638 : 30.9308$; which being made 31, with the Fractional Part, it being nearly

nearly ſo; and added (as it was an Increaſe) to 1 Deg. 21 Min. 3 Sec. found againſt 1 Sign, 15 Deg. of *Anomaly*, makes 1 Deg. 21 Min. 34 Sec. The which, as the Table directs, being ſubtracted from the aforeſaid *Mean Place* of the Sun, gives * 4 Signs, 22 Deg. 17 Min. 27 Sec. and the *True Place* of the Sun requir'd, *viz.* according to Mean or Equal Time.

* ♌ *Vide* p. 1.

But if his Place be requir'd at Noon according to Apparent Time, which is that exhibited by a True *Sun-Dial*, there muſt then, from the Tables of Equation of Time, depending on his Place, and alſo on his *Anomaly*, be taken out the Numbers anſwering to each; when, if both are to be added, or both to be ſubtracted, their Sum being accordingly added or ſubtracted, to, or from the aforeſaid Apparent Time (*viz.* at Noon) gives what it is then, Equal Time: But if one is to be added, and the other ſubtracted, their difference muſt then be added or ſubtracted, according as was to be the greater of the two Equations; which will give the Equal Time, as before.

In the preſent Example, the Equation anſwering to the Anomaly, (*viz.* 1 Sign, 15 Deg. 21 Min. and 50 Sec.) is 5 Min. 26 Sec. to be ſubtracted, and to his Place (*viz.* 4 Signs, 22 Deg. 17 Min. 27 Sec.) 9 Min. 28 Sec. *fere* to be added: Their difference therefore, 4 Min. 2 Sec. as the greater of theſe two Equations was to be added, muſt therefore be added (otherwiſe it muſt have been ſubtracted) to Noon Apparent Time; which gives what it is then, Equal Time, *viz.* when it is Noon, Apparent Time, it will be 4 Min. 2 Sec. after, Mean or Equal Time.

An Equation therefore for the ſaid 4 Min. 2 Sec. muſt be obtain'd, in order to reduce the aforeſaid Place of the Sun, found according to Equal Time, to that agreeing with Apparent Time. Thus,

In the *Table of the true Horary Motion of the Sun*, againſt his preſent Anomaly, you will find his true Horary Motion to be 2 Min. 24 Sec. Whence the Proportion is, As 1 H. 2′ 4 :: *.067$\frac{2}{3}$: .161$\frac{2}{3}$, or 10 Sec. *ferè*; which, as the ſaid Equation of Time was added, muſt therefore be added to the aforeſaid Place of the Sun at Noon, Equal Time; which gives 4 Signs, 22 Deg. 17 Min. 37 Sec. the Sun's True Place at Noon, according to Apparent Time.

* Decimal 4′ 2″.

Again, If at Noon Equal Time, for which the Sun's Place was at firſt calculated, it had been requir'd, what it was then Apparent; by ſubtracting the aforeſaid Equation, *viz.* 4 Min. 2 Sec. therefrom, the difference, 55 Min. 58 Sec. after 11 in the Forenoon, gives the Anſwer, for the Equation of Time, ſerving to reduce the Apparent to the Mean, or Equal; it is obvious, that if to 55 Min. 58 Sec. after Eleven in the Forenoon, the now Apparent Time, you add the aforeſaid Equation of Time, *viz.* 4 Min. 2 Sec. it will give Noon Equal Time, as at firſt.

Which gives this General Rule, *viz.* When the Equation of Time is Affirmative, or to be added, ſubtract it from the Equal Time, and you have the Apparent: And contrarily, when it is to ſubtracted, by adding it to the Equal, you will alſo have the Apparent.

Laſtly,

Laſtly, To obtain the Place of the Sun's *Apogé*.

FROM the Mean Place of the Sun before found, ſubtract that of the Anomaly; the difference is the Place of the *Apogé* requir'd.

IN the preſent Example, the Anomaly, 1 Sign, 15 Deg. 21 Min. and 50 Sec. being ſubtracted from the Sun's Mean Place, *viz.* 4 Signs, 23 Deg. 39 Min and 1 Sec. gives 3 Signs, 8 Deg. 17 Min. and 11 Sec. for Anſwer.

TABLATURE *of the Whole* CALCULUS.

Equal Time	☉'s *Me. Lon.*				☉'s *Me. Ano.*				
	S.	°	'	"	S.	°	'	"	
1736. *Auguſt* 4.	4	24	7	40	1	15	52	31	
2. Year à Rad. *—			28	39			30	41	—
1738. *Auguſt* 4.	4	23	39	1	1	15	21	50	Subt. from
Eq. ☉'s Cent. —		1	21	34	4	23	39	1	☉'s *Me. Pla*
☉'s Tr. Pl. Eq Ti.	4	22	17	27	3	8	17	11	☉'s Apogé.
For Eqn. Time +				10					
☉'s Tr. Pl. Ap. Ti.	4	22	17	37					

* This Character —, is call'd *leſs*, and ſignifies, that the Numbers following it, or againſt which it is placed, are to be ſubtracted.

THE

The Months of *January* and *February* only, besides the General Rule, require this particular regard, *viz.* When it is not Leap-Year, there must then be added, the Motion of a Day, to the respective *Mean Places*, &c. That is, if you require the *Mean Place* of the Sun, &c. on the First Day of the Month, you must take the Numbers answering to the Second Day, &c. But when it is Leap-Year, they come under the General Rule of the other Months.

The Reason is, the Radical Year 1736, which is Leap-Year, consists of 366 Days; the Addition of which Day (and consequently, of its Motion) did not absolutely commence till the *29th* Day of *February*; whence it was taken into the Account every following Month of the Year; and must therefore be continu'd on to the Place of its Commencement, *viz.* the *January* and *February* of the Year following, &c.

Next; The reason why every Leap-Year 'tis not regarded, is, because every single Year, or Year after Leap-Year, there is deducted by the Rule, 14 min. 19 sec. 43 thirds, and 20 fourths; the same as before, amounting in four Years, to 57 min. 18 sec. 53 thirds, and 20 fourths; which being deducted from the Motion of a Day, leaves 1 min. 49 sec. 16 thirds, and 28 fourths, the Quantity requir'd every Leap-Year to be added; which being therefore added to the *Mean Places* of *January* and *February*, every Leap-Year, as in the other Months, gives the *Mean Places* accordingly: From which Reason, the above Rule is very plain.

EX-

EXAMPLE II.

LET it be requir'd, to calculate the Sun's Place for the Year of Christ 1761, *January* the First at Noon.

FIRST, Deducting 1736, from 1761, and the Residue 25, the Years from the Radix being divided by 4, gives 6 for the Quote, and 1, the Remainder, *viz.* One Year after Leap-Year.

NEXT, As it is not Leap-Year, and the Month *January*, wherein you are calculating the Sun's Place; in the Radical Year 1736, take out the Numbers for the Sun's Mean Place, and Anomaly, against the Second of *January*; which in this case, by the Rule, will in the Year requir'd, as not being Leap-Year, answer to the First; which you will find, as in the *Tab'lature*.

THEN against 6, the Quotient, in the *Table of the Sun's Mean Motion and Anomaly*, you have 10 min. 55 sec. and 39 thirds, answering to his Mean Motion; and 13 min. 20 sec. to his Anomaly; which 10 min. 55 sec. and 39 thirds, by the Rule is to be added; but at the same time, 14 min. 19 sec. and 43 thirds, against 1, the Remainder, is to be subtracted. The Difference therefore, which is Negative (*viz.* 3 min. 24 sec.) being subtracted from the Numbers taken out *January* the 2*d*, as above, gives the Mean Place of the Sun requir'd*. But with the Anomaly it is otherwise, as having a regressive Motion: Wherefore the Numbers found against the Quote there (*viz.* 13 min. 20 sec.) as also against 1, the Remainder (*viz.* 15 min. 20 sec.) are both to be subtracted. Their Sum therefore (*viz.* 28 min. 40 sec.)

* *Vide* Tab'lature.

40 sec.) being taken from the aforesaid Anomaly, on *January* the 2d, &c. gives you the Anomaly requir'd: And thus, their Mean Places for the First of *January*, 1761, are compleated *.

* *Vide* Tab'lature.

NEXT, for the Sun's True Place.

IN the *Table of the Equation* of his *Centre*, against 6 Signs, 13 Deg. Anomaly (as in the *Tab'lature*) you find 26 min. 42 sec. and against 6 Signs, 14 Deg. are 28 min. 43 sec. The Difference is, 2 min. 1 sec. or 121 seconds: The Decimal Fraction of 30 min. 11 sec. (the Excess of the Anomaly, above 6 Signs, 13 Deg.) is .503, &c. The Proportion will be, As 1 : 121 :: 503 : 61″ *fere*: Which, as it was an Increase, being added to 36 min. 42 sec. gives 27 min. 43 sec. which, as the Table directs, being added to the Sun's Mean Place before found, gives his True; and by following the Precepts to the preceding Example, you will find also the Equation of Time, Apparent Time, likewise the Place of the Apoge to be as in the *Tab'lature* following.

TABLA-

TAB'LATURE *of the* CALCULUS.

Equal Time.	⊙ *Me. Long*	⊙ *Anomaly*	
1736. *January* 2.	9S. 22° 13′ 25″	6S. 13° 58′ 51″	
+ 25 Year, *&c.*	3 24	28 40	
1761. *January* 1.	9 22 10 1	6 13 30 11	Subt. from
Eq. ⊙ Centre	27 43	9 22 10 11	⊙ *Me. Place.*
⊙ Tr. Pl. Eq. Ti.	9 22 37 44	3 8 40 00	⊙ Apogé
Eqn. Ti. + 1′ 51″	Depending on ⊙ *Anomaly.*		
Ditto + 7 15	Depending on ⊙ Place.		
+ 9 6	50′ 54″ aft. 11 Morn. *Apparent Time.*		

THESE Examples contain all that is requiſite in calculating the Place of the *Sun*, for any time forward, or to come. I ſhall next proceed to Examples, in calculating the ſame, for any time paſt, or backward.

AS before, in calculating forward, ſo here, for the like backward. The Number of Years from the *Radix* (*viz.* 1736,) muſt be divided by 4, and the Remainder, if any, will now be ſo many Years towards the preceding *Leap-Year*; which therefore being ſubtracted from 4, gives the Number of Years from, or after the ſaid preceding *Leap-Year*; to which (when the Year you calculate for, happens not to be Leap-Year) you muſt always go back with the aforeſaid Quotient; which is

ever done, by adding Unity thereto: With which Numbers, as now prepar'd, you must enter the Table of the *Sun's Mean Motion and Anomaly*, as before, in calculating forward.

But the Numbers against the new prepar'd Quotient, are to be us'd contrarily, *viz.* Those for the Sun's Mean Place, which before were to be added, must now be subtracted; and those for the Anomaly, which in the former Case, were to be subtracted, must in this be added: But those against the prepar'd Remainder, as in calculating forward, must in both Cases be always subtracted.

From a due Consideration of the preceding Principles, the Reason of the Method in the regressive *Calculus* will be very plain and obvious.

I shall next proceed to the Illustration thereof by Examples.

EXAMPLE I.

Let the Place of the Sun at Noon, *January* the First, 1729, be requir'd.

The Number of Years from the *Radix* (viz. 1736,) by subtracting 1729 therefrom, will be found to be 7; which divided by 4, gives 1 for the Quotient, and 3 for the Remainder; Wherefore, as it is not Leap-Year, subtracting the said Remainder from 4, the Difference, Unity, shews it to be One Year from, or after the preceding Leap-Year; which Difference being also subtracted from the said Year, *viz.* 1729, gives 1728, for the Leap Year preceding; and consequently, 1729 will be the Year after, as above, &c.

Next,

Next, According to the Rule, by adding Unity, *viz.* 1, to the aforesaid Quotient, you have 2 to be operated with, as if it had been the real Quotient, and 1, the Difference (of the Remainder from 4) as if it had been also the real Remainder, and your *Calculation forward*, which, in respect to to the Year 1728 (to which Year, by the above Method, it is reduc'd) it really is: For against 2 (the now Quotient, and also Number of Leap-Years from 1736, back) in the *Table of the Sun's Mean Motion*, you have 3′ 38″ 33‴; which, if it were added to the *Radix* of the Year 1728, would by the Rule, in calculating forward, give that for 1736; and consequently, by subtracting the same from the *Radix* of 1736, you will have that for 1728: But then, as there is one Year advanc'd from the said Leap Year 1728, the Numbers against the same, as a Remainder, must be subtracted from the Mean Motion of the Sun for * 1728, thus found; both which Sums therefore, being subtracted from the Radical Mean Place of the Sun, 1736, for the said Month, Day, &c. with that requir'd, gives the Mean Place of the Sun for the same Time in the Year requir'd.

* *From which Year you now reckon forward.*

Again, As the Numbers for the Anomaly in calculating forward, against the said Quotient, is to be subtracted, 'tis plain, the Number found against 2, the now Quotient, must have been subtracted from those answering to the Year 1728, to have obtain'd the same for 1736; and consequently, by adding them to the Radicals 1736, you will have those for 1728. But the Numbers against 1, for the Year after Leap-Year, must, as before, be always subtracted. The Difference therefore, being added to, or subtracted from the

Radical Anomaly 1736, *&c.* gives (as above, in the Mean Place of the Sun) the Anomaly for the Time requir'd.

If the Number for the Anomaly against the Remainder is greater than those against the Quotient, the Difference is to be subtracted; otherwise, added.

The Regressive Method being evidently clear'd up, I shall proceed, with finishing the *Calculus*.

As the Month for which the *Sun's Place* is requir'd, is *January* the First Day, at Noon, and the Year not being Leap-Year, the *Mean Motions* answering to the Second Day in the *Radix*, must be taken, *viz.* those for the Mean Place, being 9 Signs, 22 deg. 13 min. and 25 sec. and those for the Anomaly, 6 Signs, 13 deg. 58 min. and 51 sec. The Numbers against 2, the now Quotient, are 3 min. 38 sec. and 33 thirds, for the Sun's Mean Place, and are to be subtracted: Then against 1, the Remainder, are 14 min. 19 sec. and 43 thirds also to be subtracted: Their Sum therefore, *viz.* 17 min. 58 sec. being subtracted from the Radical Mean Place, as above, gives 9 Signs, 21 deg. 55 min. and 27 sec. Sun's Mean Place for the Time requir'd.

Next, for the Anomaly, the Numbers answering to 2, the Quotient, are 4 min. 27 sec. to be added; but those against the 1, Remainder, or Year from Leap-Year, 15 min. 20 sec. to be subtracted, their Difference, *viz.* 10 min. 53 sec. being subtracted from the R*adical Anomaly* as above, gives 6 Signs, 13 deg. 47 min. and 58 sec. the Anomaly also for the Time requir'd: Proceeding as in the preceding Examples, the True Place, *&c.* will be as in the following *Tab'lature*; to which is also added, that for the Second Day of the said Month and Year.

Tab'lature

TAB'LATURE *of the* CALCULUS.

Equal Time	⊙ Me. Lon. S. ° ′ ″	⊙ Anomaly. S. ° ′ ″	
1736, *January* 2.	9 22 13 25	6 13 58 51	
— 7 Ye. à Rad.	17 58	10 53	
1729, *January* 1.	9 21 55 27	6 13 47 58	Subt. from
Eqn. ⊙ Cent. +	28 19	9 21 55 27	⊙ Me.Place
⊙ Tr. Pl. Eq. Ti.	9 22 23 46	3 8 7 29	⊙ Apogé.
Eq. Time + 1′ 53″	Depending on ⊙ Anomaly.		
Ditto + 7 9	*Ditto* ——— —— Place.		
+ 9 2	50′ 58″ after 11 Morn. *Apparent Time.*		

Equal Time.	⊙ Me. Lon. S. ° ′ ″	⊙ Anomaly. S. ° ′ ″	
1736, *January* 3.	9 23 12 33	6 14 57 59	
— 7 Ye. à Rad	17 58	10 53	
1729. *January* 2.	9 22 54 35	6 14 47 6	Subt. from
Eqn. ⊙ Cent. +	30 17	9 22 54 35	⊙ Me.Place
⊙ Tr. Pl. Eq. Ti.	9 23 24 52	3 8 7 29	⊙ Apogé.
Eq. Time + 2′ 0″	Depending on ⊙ Anomaly.		
Ditto + 7 26	*Ditto* ——— Place.		
9 26	50′ 34″ after 11 Morn. *Apparent Time.*		

IT will be neceſſary for thoſe who calculate the Sun's Place for any Series of Time, always to find the Place of the *Apoge*; which, if it continue the ſame the whole Year, it will be a Proof that the Work is ſo far right.

EXAMPLE II.

LET the Mean Place and Anomaly be requir'd the Laſt Day of *December* at Noon, preceding the Firſt Year of the Chriſtian *Æra*, at which time the ſaid Year ends, and the Enſuing commences, in Aſtronomical Calculations.

FIRST, Subtract 1 from the Radical Year 1736; the Remainder, 1735, (Years to go back to) being divided by 4, gives 433 for the Quotient, and 3, the Remainder. Therefore, as it is not Leap-Year, according to the Rule, adding Unity to the Quotient, makes 434; and ſubtracting 3, the Remainder from 4, gives 1, *viz.* One Year after Leap-Year (wherefore the Year of Chriſt's Nativity was Leap-Year;) and thus your Numbers are prepar'd for Operation.

TA-

In Table of Me. Mo. and Ano. every 4th or Leap Year.		Mean Motion.					Mean Anomaly			
		s	°	′	″	‴	s	°	′	″
Against	400	0	12	8	32	32	0	14	49	15
	30	0	0	54	38	26	0	1	6	42
	4	0	0	7	17	8	0	0	8	54
	434		—13	10	28	6		+16	4	51
For 1 new Rem.				—14	19	43			—15	20
			—13	24	47	49		+15	49	31
Mean Places of Ano.* Dec. 31. at Noon, 1st Ye. Xt.										

Rad. Me. Pl. ☉ and Anom. Jan. 1. 1736.	Mean Place.				Mean Anomaly.			
s	°	′	″	‴	s	°	′	″
9	21	14	15	54	6	12	59	43
	—13	24	47	49		+15	49	31
9	7	49	28	5	6	28	49	14
Rad. Me. Pl. ☉ and Anom. Dec. 31. 1736.								
9	20	59	56	11	6	12	44	23
	—13	10	28	6		+16	4	51
9	7	49	28	5	6	28	49	14

* See p. 110.

Or, if the Radical Places on the last of *Dec.* 1736. be taken, there will be then 1736 Years to go back, and 434 be the exact Quote, when divided by 4, the Numbers answering to which, as above, being applied in like manner, gives the Answer as before, &c.

In the first Case, *Jan.* 1. 1736 Years was gone back to, which being Leap-Year, consisted of 366 Days, but to *Dec.* 31. following are only 365, in which Time the Sun falls short 14 Minutes, 19 Seconds, 43 Thirds of one Revolution, as may be found by subtracting the Mean Place on *Dec.* 31. from that on *Jan.* 1. in the Radical Year 1736, which, answering to 1, the Remainder, as above, is therefore, as by the Rule, deducted to give the Mean Place, as required, &c.

By applying the ſame Numbers to the Mean Places on any other reſpective Radical Month and Day of the Year 1736, you will have the Mean Places for the ſaid Month and Day, in the Firſt Year of Chriſt accordingly.

In theſe Examples, the Mean Places at the Noon of the Day only have hitherto been conſidered: But if it be required for any Hour or Minute, &c. of the ſaid Day, you muſt calculate the *Mean Places* for the ſaid Day, Hour, Minute, &c. in the Radical Year 1736; when the Numbers requiſite before, to reduce them from the Noon of the ſaid Day, to that of the ſame Day of the Month in any other Year required, will reduce this laſt *Calculus* alſo, to the ſame Day of the Month, Hour, &c. in the Year required, as was the ſaid *Calculus* in the Radical Year.

EX-

EXAMPLE.

LET it be requir'd, to calculate the Place of the *Sun*, on *December* 12, 1738, at 5 h. 27 min. *P. M.* or *Afternoon.*

TABLTURE.

Equal Time.	☉ Me. Long.					☉ Me. Ano.				
	S.	°	'	"	'''	S.	°	'	"	
1736, *Decemb.* 12	9	2	15	21	6	9	23	59	51	
Hour 5 +			12	19	0			12	19	
Min. 27 +			1	6	32			1	7	
	9	2	28	46	38	5	24	13	17	
2 Year à Rad. —			28	39	27			30	41	
1738, *Dec.* 12, &c.	9	2	0	7	11	5	23	42	36	Subtr. from
Eqn. ☉ Cent. —			13			9	2	0	7	☉ Me. Place.
☉ True Place	9	1	47	7	11	3	8	17	31	☉ Apoge.
Equ. Time —	0' 52" depending on ☉ Anomaly.									
Ditto - - +	0 38 *ditto* — — — Place.									
—	0 14, *viz.* 5 Ho. 27' 14" Apparent Time.									

In this Example, the Thirds are made uſe of, which, in the End, if under 30 (as before obſerv'd) may be neglected: if above 30, the Seconds are made One more for them, &c. but in the Anomaly, they are altogether neglected, being there of no moment.

Thus, having given Examples in all Caſes, requiſite for determining the Place of the Sun, I ſhall next proceed to thoſe for the Moon, from theſe New Tables, digeſted according to Sir *Iſaac Newton*'s Theory.

The Principles on which the Tables of the *Mean Motion of the Moon*, the *Apoge* and *Node*, are built, are the ſame with thoſe of the Sun.

It is to be obſerv'd, that the Numbers here againſt the Remainders, or Years after Leap-Year, are always to be added, excepting in the Node, which, like the Anomaly of the Sun, has a regreſſive Motion.

The Reaſon is, that in a common Year of 365 Days, the Moon, ſuppoſing her (as before of the Sun) in the firſt Point of *Aries*, will, by her Mean Motion, over and above her Revolutions, have mov'd 4 Signs, 9 Deg. 23 min. and 4 ſec. beyond the ſaid Point, at the Expiration of the ſaid Year; which therefore muſt be added to the ſaid Point, in order to obtain her Mean Place.

The Mean Motion of the Moon for four ſingle Years, is 5 Signs, 7 Deg. 32 min. and 14 ſec. as may be found, by adding together the Numbers againſt 3, and 1, in the Remainders; but every Leap-Year having a Day more added thereto, there muſt alſo the Motion of a Day be

be taken in, *viz.* 13° 10′ 35″; which added to the aforeſaid Four ſingle Years Motion, make 5 S. 20° 42′ 49″, the Motion for every Leap-Year; which you find in the Table of her *Mean Motions*, &c. The like is to be underſtood of the Apoge; alſo of the Node, with regard to its Regreſſive Motion.

As Examples beſt conduce to clear up theſe *Calculi*, I ſhall, (as before of the Sun) have immediate recourſe thereto.

EXAMPLE I.

Let the Moon's Place be requir'd, *Decemb.* 12, 1738, *at* 5 ho. 27′ *P.M.*

For the Firſt Equation of the Moon.

THE Moon's Mean * Place, *Dec.* 12, 1736, at Noon, &c. is, 5 S. 14 Deg. 23 min. and 44 ſec; that of the Apoge, 0 S. 1 Deg. 8 min. and 57 ſec. and that of the Node, 5 S. 22 Deg. 5 min. and 59 ſec.

* *Vide* Tab'lature *and Table for the Mean Places of* ☽, &c. *every Day of the ſaid Year.*

Next, As there are two ſingle Years from the *Radix*, which are to be taken as Remainders, (as before of the Sun) againſt which, as ſuch, you have 8 S. 18 Deg. 46 min. and 7 ſec. for the Mean Motion of the Moon; 2 S. 21 Deg. 19 min. and 41 ſec. for that of the Apoge; and 1 S. 8 Deg. 39 min. and 26 ſec. for that of the Node: The two former of which, being added to, and the latter ſubtracted from the reſpective Radicals, give the Mean Places on the ſaid *Dec.* 12, as above, 1738, viz. 2 S. 3 Deg. 9 min. and 51 ſec. Moon's Mean Place; 2 S. 22 Deg. 28 min. and 38 ſec.

for the Apoge; and 4 S. 13 Deg. 25 min. and 35 sec. for that of the Node.

Next, With the Sun's Anomaly, entring the Tables for the First Equation, according to each respective *Title*, viz. *Moon*, the *Apoge* and the *Node*, operating as before, in Equating for the Sun's Centre, you will have (as each particular Table directs) the Equation, 1 min. 18 sec. to be added to the Moon's Mean Place; or Longitude, 2 min. 13 sec. to be subtracted from that of the Apoge; and 1 min. 3 sec. to be added to that of the Node: And this is call'd, the *First Equation* of each; which now gives 2 S. 3 Deg. 11 min. and 9 sec. the Mean Longitude, 2 S. 22 Deg. 26 min. and 25 sec. Apoge; and 4 S. 13 Deg. 26 min. and 8 sec. for the Node.

Before you can proceed any farther, the True Place of the Sun, &c. must be had for the same Time with that of the Moon requir'd; which, indeed, is the Basis of all; and therefore is plac'd first, as in the *Tab'lature*.

For

For the Second Equation of the Moon.

SUbtract the Apoge the first time Equated, from the True Place of the Sun; the Difference gives the Numbers, with which you must Enter the *Table of the Second Equation of the Moon*; and in the same Column with the Sign, either at the Head or Bottom of the Table; and against the Degree, *&c.* in the Side thereof you will have an Equation; and also against the said Equation, an Increment, which must be proportion'd, as occasion requires: All which, in this Equation, may be done, as it were, by Inspection.

In the present Example, the Place of the Apoge the First time Equated, is 2 S. 22 Deg. 26 min. and 25 sec. which subtracted from the true Place of the Sun, *viz.* 9 S. 1 Deg. 47 min. and 7 sec. gives 6 S. 9 Deg. * 20 min. and 42 sec. In the Table, against 6 S. 9 Deg. are 1 min. 6 sec. and against 6 S. 10 Deg. are 1 min. 13 sec. Their Difference is 7 sec. a proportional Part of which must be taken for the 20 min. 42 seconds, above 6 S. 9 Deg. which being about one third Part of a Degree, therefore one third Part of 7 seconds (which let be 2 seconds) must be added (as it was an Increase) to 1 min. 6 sec. which makes 1 min. 8 sec.

* *The Distance being often made use of in the Calculus, the Minutes and Seconds thereof being reduced to an exact Decimal, are placed in the* Tab'lature, *thereby saving the trouble of often taking the same out of the* Table.

Next,

NEXT, The Increment againſt the ſaid 6 Signs, 9 Degrees, is found to be 7 ſeconds (the Proportioning in this Caſe, being of no moment ;) which ſaid Increment requires alſo to be proportion'd thus : Firſt, in the little Table for that purpoſe, take out the Number anſwering to the Sun's preſent Anomaly. Then the Proportion will always be, As 22, the greateſt Number in the Table, is to the Number thus taken out ; ſo is the Increment before found, in the Firſt Table, to the preſent Increment : Which being added to the former Equation, and this laſt Reſult apply'd as the Table directs, to the Moon's Place, the Firſt time Equated, gives her Place Equated the Second time.

IN the preſent Example, the Number anſwering the preſent Anomaly, *viz.* 5 Signs, 25 Degrees, *&c.* is 22, the greateſt Number in the ſaid Table ; conſequently, 7 Seconds, the Increment before found, will ſtill be 7 Seconds, as at firſt ; the which added to the Equation at firſt found, *viz.* 1 min. 8 ſec. gives 1 min. 15 ſec. which, as the Table directs, being ſubtracted from the Moon's Place the firſt time Equated, *viz.* 2 S. 3 Deg. 11 min. and 9 ſec. gives 2 S. 3 Deg. 9 min. and 54 ſec. the Moon's Place the Second time Equated.

For

For the Third Equation of the Moon.

SUbtract the First Equated Place of the Node from that of the Sun; with the *Difference* enter the *Table of the third Equation of the Moon*; against which, &c. you will have an Equation; which apply'd, as the Table directs, to the Moon's Place the Second time Equated, gives her Place Equated the Third time.

In the *present Example*, the Place of the Node the First time Equated, is, 4*S.* 13 Deg. 26 min. and 8 sec. and that of the Sun, 9*S.* 1 Deg. 47 min. and 7 sec. The *Difference* is, 4*S.* 18 Deg. 20 min. and 59 sec. Against which, in the *Table for the third Equation*, are 47 seconds, to be subtracted from the Moon's Place, the Second time Equated, *viz.* 2*S.* 3 Deg. 9 min. and 54 sec. which gives 2*S.* 3 Deg. 9 min. and 7 sec. for the Place of the Moon the Third time Equated.

For the Fourth Equation of the Moon.

FROM the Place of the Moon the Third time Equated, subtract the True Place of the Sun, reserving the Remainder.

Next, From the Place of the Moon's Apoge, the First time Equated, subtract that of the Sun's Apoge. With the Sum of these two Remainders (rejecting the Circle, or 12 Signs, if they exceed it) Enter the *Table of the Fourth Equation of the Moon*; against which, &c. you will have an Equation; which order'd as the Table directs, gives the Place of the Moon the Fourth time Equated.

In

In the present Example, the Place of the Sun, *viz.* 9 *S.* 1 Deg. 47 min. and 7 sec. being subtracted from 2 *S.* 3 Deg. 9 min. and 7 sec. the Place of the Moon the Third time Equated, gives 5 *S.* 1 Deg. 22 min. and 0 sec.

Next, 3 *S.* 8 Deg. 17 min. and 31 sec. the Place of the Sun's Apoge, being also subtracted from 2 *S.* 22 Deg. 26 min. and 25 sec. the Place of the Moon's Apoge the First time Equated, gives 11 *S.* 13 Deg. 18 min. and 54 sec. Both which Remainders, the Circle being rejected, gives 4 *S.* 15 Deg. 10 min. and 54 sec. Against which, in the Table of the *Fourth Equation of the Moon*, are, 1 min. 43 sec. to be subtracted from the aforesaid Place of the Moon, the Third time Equated, *viz.* 2 *S.* 3 Deg. 9 min. and 7 sec. which gives 2 *S.* 3 Deg. 7 min. and 24 sec. the Place of the Moon, the Fourth time Equated.

For the Second Equation of the Moon's Apoge.

With the Difference, or Distance of the *Apoge*, the First time Equated, from the Sun, you must Enter the *Table of the Second Equation of the* Apoge; against which, *&c.* proportion'd, if requisite (and which Proportion must here be very acurate,) you will have an Equation, which added, or subtracted, as the Table directs, to, or from the First Equated Place of the *Apoge*, gives the Place of the *Apoge* the Second time Equated.

In the present Example, the aforesaid Distance [*Vide* the *Second Equation*,] is 6 *S.* 9 Deg. 20 min. and 42 sec. The 20 min. 42 sec. reduc'd an

to an exact Decimal, or taken out of the Table, is .345. Then in the *Table of the Second Equation of the Apoge*, Against 6 *S.* 9 Deg. are, 3 Deg. 8 minutes; and against 6 *S.* 10 Deg. are, 3 Deg. 28 min. and 27 seconds: The Difference is, 20 min. 27 seconds; the Decimal of which, taken out of the Table, is, .34083: Whence the Proportion will be, As 1° : .341 * : : .345 : . 117645; *V. P. 95. which being reduc'd, will be found to be 7 min. 3 seconds *fere*; which being added to 3 Deg. 8 minutes, against 6 Deg. 9 minutes, &c. (as the same was increasing) gives 3 Deg. 15 min. and 3 sec. for the Second Equation of the *Apoge*; which added, as the Table directs, to the *Apoge*, the First time Equated, *viz.* 2 *S.* 22 Deg. 26 min. and 25 sec. gives 2 *S.* 25 Deg. 41 min. and 28 sec. for the Place of the *Apoge*, the Second time Equated.

****

For the Mean Anomaly of the Moon.

FROM the Place of the Moon the Fourth time Equated, subtract the Place of the Moon's *Apoge*, the Second time Equated; the Remainder is the Mean Anomaly of the Moon sought.

In the present Example, the Place of the Moon the Fourth time Equated, is, 2 *S.* 3 Deg. 7 min. and 24 seconds; from which subtracting 2 *S.* 25 Deg. 41 min. and 28 seconds, the Place of the Moon's Apoge, the Second time Equated, the Remainder, *viz.* 11 *S.* 7 Deg. 25 min. and 56 seconds,

conds, is the Mean Anomaly of the Moon sought.

For the Elliptic Equation of the Moon.

WITH the Mean Anomaly of the Moon, enter the Table, titled, *The Mean Elliptic Equation* thereof; from which take out the Numbers answering to the said Mean Anomaly; which Numbers will be the Mean Elliptic Equation sought.

NEXT, The aforesaid Distance of the Moon's Apoge the First time Equated, from the Sun, must be prepar'd in the manner following, *viz.*

LET the same, if under 3 Signs, &c. be reduc'd to Degrees, which will then be prepar'd accordingly.

IF the same be above 3, and under 6 Signs, subtract it from 6 Signs; the Remainder reduc'd to Degrees, will also be accordingly prepar'd.

IF it exceeds 6 Signs, subtract 6 Signs therefrom. The Remainder, being order'd according to one of the two former Precepts, as requisite, gives the prepar'd Degrees, &c. requir'd.

LASTLY, With the Mean Anomaly, enter the Table, titled, *The Reduction of the Mean Elliptic, to the True Elliptic Equation of the Moon.*

WHEN in the Column answering to the said Mean Anomaly, and against the aforesaid prepar'd Number in the Margins, or outer Columns, either

either to the right or left hand, you have an Equation; which added to, or subtracted from the Mean Elliptic Equation before found, gives the True Elliptic Equation requir'd.

In the present Example, the Mean Anomaly of the Moon is, 11 S. 7 Deg. 25 min. and 56 sec. In the Table of the *Mean Elliptic Equation*, against 11 S. 7 Deg. are 2, Deg. 20 min. and 44 seconds; and against 11 S. 8 Deg. are, 2 Deg. 14 min. and 53 sec. The Difference is, 5 min. 51 sec. or 351 seconds.

Next, The Decimal of 25′ 56″ is, .437; which multiply'd by 351″, gives 152″ *fere*, viz. 2′ 32″, to be subtracted (as the said Equation was decreasing) from 2 Deg. 20 min. and 44 sec. against 11 S. 7 Deg. of Anomaly; which gives 2°. 18′ 12″ Mean Elliptic Equation, to be added, as the Table directs, to the Fourth Equated Place of the Moon; But, (as before) there is requir'd a Prosthapheresis for the Reduction of this Mean to the True Elliptic Equation requir'd, to be obtain'd, thus:

In the present Example, the Distance of the Moon's Apoge, &c. from the Sun (6 Signs, as before noted, being rejected) is, 9 Deg. 20 min. and 42 sec. and the Mean Anomaly as before, 11 S. 7 Deg. 25 min. and 56 sec. In the Table for the *Reduction of the Mean Eliptic Equation*, &c. to the True, against 8, the next less Marginal Number to the prepar'd Degree, and in the Column of 11 S. 6 Deg. the next less Degree also of the Mean Anomaly, you have 25 min. 56 sec. also against 10, the next greater Marginal Number to the prepar'd Degree in the Column of the said 11 S. 6 Deg. of Anomaly, you have 25 min. 26 sec. The Difference

of these two is 30 sec. and the Decimal of 20′ 42″, belonging to the prepar'd Number, out of the Table, &c. is .345; the Proportion will therefore be, As 2, the Difference between 8 and 10 (the outer, or Marginal Numbers) is to 30″, (the Difference of the Numbers answering to the said Marginal Numbers, &c.) so is 1°.345, (the Difference between the lesser Marginal Number, and the true prepar'd Number, &c.) to 20″; which subtracted from 25 min. 56 sec. gives 25 min. 36 sec. the true Equation answering to 11 S. 6 Deg. Anomaly, and 9 Deg. 20 min. and 42 sec. the true prepar'd Number, as before.

NEXT, As the Mean Anomaly in the present Example, is, 11 S. 7 Deg. 25 min. and 56 sec. the same Proportions as before, must be made with the next greater Anomaly, *viz.* 11 S. 9 Deg. the Table being calculated to every 3 Degrees of Anomaly; and thus, against 11 S. 9 Deg. and also against 8 (as before, &c.) is 22 min. 45 sec. and at the same time, against 10, is 22 min. 17 sec. Their Difference is 28 sec. when the Proportion, (as before, &c.) will be, As 2° : 28″ : : 1°.345: 18.83, or 19″; which being subtracted, for the above reason, from 22 min. 45 sec. gives 22 min. 26 sec. for the True Equation, at 11 S. 9 Deg. of Anomaly.

LASTLY, The Difference of these two last Equations is 3′ 10″, or 190″ decreasing, *viz.* in Three Degrees of Anomaly, from 11 S. 6 Deg. to 11 S. 9 Deg. But the Mean Anomaly in the present Example, is, 11 S. 7 Deg. 25 min. and 56 sec. The Difference between which, and the next lesser in the *Table of Reduction*, &c. is 1 Deg. 25 min. and 56 sec. The Decimal of 25′ 56″ is .432.

Where-

Wherefore, the Proportion will be, If 3 Degrees of nomaly decrease 190 Seconds, what will 1.437 ecrease? Which will be found to be 90 Seconds, r 1 Minute, 30 Seconds; which subtracted, s it was a Decrease, from 25 min. 36 sec. before ound, gives 24 min. 6 sec. to be added, as the Table directs, to the aforefound Mean Elliptic Equation, *viz.* 2 Deg. 18 min. and 12 sec. which ives 2 Deg. 42 min. and 18 sec. the true Elliptic Equation requir'd; which, according as the Table of the *Mean Elliptic Equation* before directed, being added to the Place of the Moon the Fourth time Equated, *viz.* 2 S. 3 Deg. 7 min. and 24 sec. gives 2 S. 5 Deg. 49 min. and 42 sec. for he Place of the Moon the Fifth time Equated.

It may be observ'd, that these Equations being minute, their Proportions appear almost at ight: For the Marginal Number differing always by 2, half of either the Second or Third Term in the Proportion, multiply'd into the other, gives the Answer, &c. [*Vide* the following *Tablet.*]

TABLET.

TABLET.

Dist. Apo. ☽ Ti. Equated à ☉ 9°.27	Me. Ano. ☽ 11 S. 6°	Me. Ano. ☽ 11 S. 9°
	° ′ ″	° ′ ″
Marginal Numbers } 8	0 25 56	0 22 45
10	0 25 26	0 22 17
Differences	30	28
Diff tr. Dist. ☽ *Ap.* 1°. *Ti. Eqd.* à ☉ and lesſ. Marg. Numb. Half aforeſaid Differences	1.345 (*Mult*) 15	1.345 (*Mult.*) 14
Equations ſubtract — —	20″	19″
Eqns. tr. Diſt. Apo. ☽ à ☉	0 25 36	0 22 26
Diff. ditto *to gr. and leſſ. Ano.*	3′ 10′	or 190″
Diff. tr. and leſſ. Anom.	1.437⅓ dit. *Multip. by*	.4774 190
25′ 36″ leſs 1′ 30″ gives	Tr. Equar. + 24 6	90 *

* The Decimal in this Equation is omitted, that in the Mean Anomaly being made an Unit; which is more of Curioſity than Uſe, and would have been but a Second odds, if this had been made an Unit alſo.

For the Variation, or 6th *Equation of the Moon.*

FROM the Place of the Moon the Fifth time Equated, ſubtract the True Place of the Sun: With this Difference enter the Table, titled as above; where you muſt operate with the reſpective Numbers, in all reſpects, as before, in the Second Equation; which will give you the Place of the Moon the Sixth time Equated.

In this Equation, where you enter with the Sun's Anomaly, as the Numbers are greater than in the Second Equation, I have given a Table of the Decimal Multiplicators; which taken out in the ſame manner, againſt the Sun's preſent Anomaly, as above in the Integers; and by which multiplying the Increment before found in the Table with the Diſtance of the Sun from the Moon, gives the Increment proportion'd, as requir'd.

In the preſent Example, the Sun's True Place, *viz.* 9 S. 1 Deg. 47 min. and 7 ſec. ſubtracted from the Fifth time Equated, *viz.* 2 S. 5 Deg. 49 min. and 42 ſec. gives 5 S. 4 Deg. 2 min. and 35 ſec. Againſt which, in the Table, are, 26′ 3″, and 206″ Increment.

Next, Againſt the Sun's preſent Anomaly in the Table for the preſent Increment, &c. the Decimal Multiplicator is Unity; by which, multiplying the aforeſaid Increment, *viz.* 206″, it will be the ſame as before (as it was in the Second Equation;) which being therefore added to the Equation at firſt found, *viz.* 26′ 3″, gives 29′ 29″, to be ſubtracted, as the Table directs, from the Place of the Moon, the Fifth time Equated,

viz.

viz. 2 S. 5 Deg. 49 min. and 42 sec. gives 2 S. 5 Deg. 20 min. and 13 sec. the Place of the Moon the Sixth time Equated.

For the Seventh Equation of the Moon.

FROM the Place of the Moon, the Sixth time Equated, subtract the True Place of the Sun; with this Distance enter the Table of the *Seventh Equation of the Moon*; and against the same, you have an Equation; which added or subtracted, as the Table directs, gives the Place of the Moon the Seventh time Equated; which is her Place in her Orbit.

EXAMPLE.

IN the present Example, the Sun's True Place, *viz.* 9 S. 1 Deg. 47 min. and 7 sec. being subtracted from the Sixth Equated Place of the Moon, *viz.* 2 S. 5 Deg. 20 min. and 13 sec. gives 5 S. 3 Deg. 33 min. and 6 sec. Against which, in the *Table of the Seventh Equation of the Moon*, you have 1' 2'' to be subtracted from the Place of the Moon, the Sixth time Equated, *viz.* 2 S. 5 Deg. 20 min. and 13 seconds; which gives 2 S. 5 Deg. 19 min. and 1 sec. the Place of the Moon, the Seventh time Equated.

BEFORE her Place can be reduc'd to the Ecliptic, there must first be found the True Place of the Node. Thus,

FROM the Sun's True Place, subtract that of the Node the First time Equated; with this Difference, enter the *Table of the Second Equation of* th

the Node, and Inclination of the Limit, &c. Against which (proportion'd, as in the other Example) you will have an Equation; which added to, or subtracted from (as the Table directs) the aforesaid first Equated Place of the Node, gives the True Place requir'd. In the said Table also, you must take out (proportion'd in the same manner, *&c.*) the Inclination of the Limit.

Next, Subtract the True Place of the Node thus found, from the Place of the Moon in her Orbit: With this Difference, enter the *Table of Reduction and Excess*, &c. taking out the Equation answering thereto, as also the Excess; which Excess must be proportion'd, *viz.* As the greatest Inclination of the Limit, above the least, *viz.* 17′ 45″, is to the present (taken out of the Second Equation of the Node;) So is the Excess, taken out of the Table, as above, to the present Excess: Which being added to the Simple Reduction, taken out, as above directed, gives the True Reduction; which added, or subtracted, as the Table directs, to, or from the Moon's said Place in her Orbit, gives her True Place in the Ecliptic, requir'd.

In the present Example, the Node first Equated, from the Sun, was found (as in the Third Equation of the Moon) to be 4 S. 18 Deg. 20 min. and 59 seconds; against which, in the *Table of the Second Equation of the Node, proportion'd*, &c. you have 1 Deg. 28 min. and 50 seconds, Equation, to be subtracted from the First equated Place of the Node, *viz.* 4 S. 13 Deg. 26 min. and 8 seconds; which makes 4 S. 11 Deg. 57 min. and 18 seconds, the True Place of the Node

T requir'd;

requir'd; and the Inclination of the Limit in the Table, at the ſame time, is 10′ 1″.

Next, From the Place of the Moon in her Orbit, *viz.* 2 S. 5 Deg. 19 min. and 11 ſeconds, ſubtract the aforeſaid True Place of the Node, *viz.* 4 S. 11 Deg. 57 min. and 18 ſeconds; with the Difference, *viz.* 9 S. 23 Deg. 21 min. and 53 ſeconds, enter the *Table of Reduction and Exceſs*; againſt which, for the Simple Reduction Equation, you have 4′ 45″, and alſo 35″ for the Exceſs: Which Tabular Exceſs is to be proportion'd as before directed, As the greateſt Inclination, *viz.* 17′ 45″, is to the preſent, 10′ 1″; So is 35″, the Tabular Exceſs, to 20″, that ſought: Which being added to the Simple Reduction Equation, *viz.* 4′ 45″, gives 5′ 5″, for the Equation of Reduction and Exceſs, in the ſaid preſent Example: Which being added to the Place of the Moon in her Orbit, according to the Direction of the Table, gives 2 S. 5 Deg. 24 min. and 16 ſeconds, the True Place of the Moon in the Ecliptic, requir'd.

Or, If the Product of the preſent Inclination of the Limit, and preſent Tabular Exceſs, be multiply'd by the Conſtant Factor .0563, you will have the proportion'd Exceſs requir'd.

For

For the Latitude of the Moon.

WITH the aforesaid Distance of the Node, the Second time Equated, from the Moon in her Orbit, enter the *Table of the Moon's Latitude*, &c. taking out the Simple Equation against the same (proportion'd, *&c.*) as also the Increment; which Increment must be proportion'd in the same manner, and with the same Numbers as before in the Excess; which Increment so proportion'd, being always added to to the Simple Latitude, gives the Moon's True Latitude sought.

IN the present Example, the aforesaid Distance of the Node from the Moon, is, 9 S 23 Deg. 21 min. and 53 seconds; against which, in the Table aforesaid (proportion'd) you have 4° 35′ 1″, the Simple Latirude South Descending; also 16′ 17″, for the Increment; which proportion'd, as before in the Excess, gives 9′ 11″; which being added to the aforesaid Simple Latitude, *viz.* 4° 45′ 1″, gives 4° 44′ 12″, True South Latitude Descending of the Moon requir'd.

For the Eccentricity of the Moon.

WITH the aforesaid Distance of the Apoge, the First time Equated from the Sun, Enter the *Table of Eccentricities*; where operating with those Numbers, as in other Equations, &c. you will have the Eccentricity requir'd.

IN the present Example, the said Distance has been found to be 6 S. 9 Deg. 20 min. and 42 seconds *, and the Decimal of the 20 min. 42 sec. .345. Against 6 S. 9° is 66302; and against 6° 10′ 66192; their Difference is 110, decreasing; which, being multiply'd by .345, gives 38 *fere*; which being subtracted from 66302 (as it was decreasing) gives 66264, the Eccentricity requir'd.

* *Vide the* Tab'lature.

For the Moon's Horizontal Parallax.

ENTER the TABLE thereof, at the greatest and least Eccentricities, with the Mean Anomaly of the Moon before found; against which, find the Horizontal Parallaxes to the said greatest and least Eccentricities, and take their Difference: Next, subtract the least Eccentricity from the present. Then, As the difference of the least and greatest Eccentricities, is to the difference between the least and present Eccentricities; So is the aforesaid difference of the Horizontal Parallaxes, to the present Difference thereof: Which being added, or subtracted, as the nature

nature of the same requires, gives the present Horizontal Parallax sought.

EXAMPLE.

In the present Example, the Mean Anomaly of the Moon is, 11 S. 7 Deg. 25 min. and 56 sec. the Horizontal Parallaxes answering thereto, are, 54′ 8″, and 55′ 17″, and the Difference, 1′ 9″ decreasing. The Difference between the greatest and least Eccentricities, which is a constant Quantity, as in the Table, is, 23454; and the Difference between the least Eccentricity, *viz.* 43319, and the present, before found, *viz.* 66264, is 22945: Then the Proportion, as above, is, As 23454 : 22945 :: 69″ : 68″ *fere*; Which, as it is decreasing, being subtracted from the aforesaid 55 min. 17 seconds, gives 54 min. 9 seconds, the Horizontal Parallax requir'd; supposing the Moon to be in the *Syzygys*, viz. in the Conjunction or Opposition: Otherwise, from the true Place of the Moon last found, subtract the true Place of the Sun; with this Difference, enter the *Table for the Horizontal Parallax out of the* Syzygys; from whence taking the Decimal Multiplicator, and multiplying the present Horizontal Parallax thereby, gives an Equation; which must always be subtracted from the Horizontal Parallax before found, for the *Syzygys*; which Remainder will then be the true Horizontal Parallax requir'd.

In the present Example, the Decimal Multiplicator will be found to be .383; by which multiplying 54′.15, the Horizontal Parallax in the *Syzygy* before found, the Product will be 21″ *fere*; which subtracted from 54′ 9″, the Horizontal Parallax in the *Syzygy*, gives 53′ 48″, the true Horizontal Parallax requir'd.

For

For the Horizontal Semidiameter of the Moon.

AS the Mean Horizontal Parallax, 57 min. 30 seconds, is to the Mean Horizontal Semidiameter, 15 min. 45 seconds; so is the present Horizontal Parallax, to the present Horizontal Semidiameter.

As the Mean Horizontal Parallax and Semidiameter are constant Quantities; their *Ratio*, viz. .274, will be a constant Quantity: By which, if you always multiply the present Horizontal Parallax, you will have the Horizontal Semidiameter of the Moon requir'd.

In the present Example, the Horizontal Parallax, *viz.* 53′.8 multiply'd by .274, gives 14′.7412, *viz.* 14 min. 44 seconds, the Horizontal Semidiameter of the Moon requir'd.

TABLA-

TABLATURE *of the Whole* CALCULUS.

1735, Equ. Time. h. *Dec.* 12.5 27 *P.M.*	☉ true Place S. ° ′ ″ 9 1 47 7	☽ Mean Anom. S. ° ′ ″ 5 23 46 36	☉ Apogé. S. ° ′ ″ 3 8 17 31
Equal Time.	☽ Me. Long S. ° ′ ″	☽ Apogé S. ° ′ ″	☽ Node ☊ S. ° ′ ″
1736, *Dec.* 12, *Nn.*	5 11 24 13	9 1 7 25	5 22 5 15
Ho. 5 +	2 44 42	1 24	Sum — 44″ { 40
Min. 27 +	14 49	8	4
	5 14 23 44	0 1 8 57	5 22 4 31
Year 2. à Rad. +	8 18 46 7	+ 2 21 19 41	— 1 8 39 26
1738, *Dec.* 12, &c.	2 3 9 51	2 22 28 38	4 13 25 5
1st Equation +	1 18	— 2 [illegible] 13	+ 1 3
☽ Equd. *1st* time	2 3 11 9	2 22 26 25	4 13 26 8
2d Equation —	1 15	6 9 20 42 .345	4 18 20 59 ☊ Node à ☉
☽ Equd. *2d* time	2 3 9 54	☽ Apog. à ☉	— 1 28 50
3d Equation —	47	4 15 10 54 ☉ *Ap.* à ☽ *Ap.* &c	☊ *2d Eqn. Node*
☽ Equd. *3d* time	2 3 9 7	+ 3 15 3	4 11 57 18 ☊ tr. Pla. Node
4th Equation —	1 43	*2d.* Eqn. ☽ Ap.	Incl. Limit 10′
☽ Equd *4th* time	2 3 7 24	2 25 41 28	9 23 21 53
Elliptic Equat. +	2 42 18	Ap. ☽ 2. ti. Eqd.	☊ à ☽ in her *Orb.*
☽ Equd. *5th* time	2 5 49 42	11 7 25 56 .437	Reduct. 4′ 45″
Variation —	29 29	☽ Me. Anom	*Tab Exc.* 35″ pr. 20′
		5 4 2 35 ☉ à ☽ *5th* ti. Eqd	☽ M. Lt. *so. Desc.* } 4° 35′ 1″
☽ Equd. *6th* time	2 5 20 13		
7th Equation	1 2		*Tab Increm.* 16′ 17″. *Present* 9′ 11″.
		5 3 33 6 ☉ à ☽ *6th* ti. Eqd	
☽ in her Orbit	2 5 19 11		Eccen. 66264
			Hor. Paral. 53′ 48″
Red. and Exc. +	5 5		D°. Semid. 14′ 44″
☽ in the Eclipt.	2 5 24 16		
☽ *Tr. Lat.* So. desc.	4 44 12		

FOR a Confirmation of the Truth of the former Method, in obtaining the true *Elliptic Equation* of the Moon, I shall here exhibit an easy Logarithmic Calculation thereof, with the *Data* of the present Example, *viz.*

WITH the aforesaid Distance of the Moon's Apoge, the First time Equated from the Sun, enter the Table, titled, *Constant Logarithms for the Elliptic Equation of the Moon*; which, as before, of the Eccentricity, must be taken out, and proportion'd, as requisite.

IN the present Example, in the said Table, against 6 Signs, 9 Degrees, you find 9.942326; and against 6 Signs, 10 Degrees, 9.942423; their difference is, 97, increasing, &c. which 97 being multiply'd into .345, the Decimal of the Excess of the aforesaid Distance, above 6 Signs, 9 Degeees *, gives 33; which, as it was an Increase, being added to the aforesaid Constant Logarithm, against 6 Signs, 9 Degrees, *viz.* 9.942326, gives 9.942359, for that in the present Example requir'd.

* *Vide* Tab'lature.

NEXT, In the Table, titled, *An Equation to half the Mean Anomaly of the Moon*, seek at the Head thereof, the first Four left hand Digits, or Places of the afore-found constant Logarithm; in which Column, and against the present Mean Anomaly of the Moon, you have an Equation, which, as the Table directs, must be added to, or subtracted from, half the said Mean Anomaly of the Moon.

In the preſent Example, the Mean Anomaly of the Moon, *viz.* 11 S. 7 Deg. 25 min. and 56 ſeconds, being ſubtracted from the Circle, or 12 Signs, gives 0 S. 22 Deg. 34 min. and 4 ſeconds: Againſt which proportion'd, *&c.* and under 9.942, the Firſt four Digits of the Conſtant Logarithm, you have 1 min. 23 ſeconds, an Equation, to be added to half of the afore-order'd Mean Anomaly, *viz.* 0 S. 11 Deg. 17 min. and 2 ſeconds; which gives 0 S. 11 Deg. 18 min. and 25 ſec.

It may be obſerv'd in the Conſtant Logarithm at any time thus found, that if the Fifth Place, beginning at the fartheſt to the left hand, exceeds 5, *viz.* be 7, 8, *&c.* you muſt then make the preceding Place an Unit more, to enter the Table with: But if under 5, *&c.* it is then to be neglected.

If the Conſtant Logarithm thus prepar'd, cannot be exactly had in the Table, take the next Leſſer therefrom, and note the difference; when it will be, As the differenoe between the ſaid leſſer Logarithm, and next greater in the Table (which is always 5,) is to the aforeſaid noted difference; ſo is the Difference of the Equations anſwering to the ſaid greater and leſſer Logarithms, to an Equation; which being (always) ſubtracted from the Equation anſwering to the leſſer Logarithm in the Table, gives the Equation anſwering to the preſent Conſtant Logarithm; which muſt be added, or ſubtracted, to, or from half of the preſent Mean Anomaly, as before, *&c.*

Lastly,

LASTLY, To the Tangent of half the Mean Anomaly thus Equated, add the Constant Logarithm thus found; which will give the Tangent of an Arch; the which being subtracted from half the Mean Anomaly, and the Remainder doubled; gives the True Ecliptic Equation sought.

IN the present Example, the Tangent of half the Mean Anomaly thus Equated, *viz.* 11 Deg. 18 min. and 25 sec. is, 9.300912; which added to the Constant Logarithm before found, *viz.* 9.942359, gives 9.243271, the Tangent of 9 Deg. 55 min. and 53 sec. which subtracted from half the Mean Anomaly, before it was Equated, *viz.* 11 Deg. 17 min. and 2 sec. gives 1 Deg. 21 min. and 9 seconds; which doubled, gives 2 Deg. 42 min. and 18 seconds, the true Elliptic Equation requir'd, the same with that found, as before, &c.

THIS Example, well understood and practis'd, will be found sufficient for Calculating the Moon's Place, any time forward, or to come.

To Calculate the Place of the Moon for any time past.

YOU must first, as before (and always) obtain the Sun's True Place, &c. for the same time with that of the Moon, requir'd.

NEXT, In the Radical Year 1736, for the Day and Hour, &c. requir'd, take out the Mean Places answering thereto, as in the preceding Example.

THEN, the Number of Years back from the *Radix*, must, in all respects, be order'd, as before of the Sun; with which, entring the *Table of the Mean Motions, and Remainders of the Moon, Apoge*, &c. you will have the Numbers; which apply'd, as there directed, to those before found in the Radical Year 1736, will reduce the same to the Mean Places, &c. for the same Day of the Month, Hour, &c. in the Year requir'd.

EXAMPLE.

LET it be requir'd, to Calculate the Moon's Place on *January* the 2*d*, 1729, at Noon.

THE Number of Years back from the *Radix*, viz. 7, being prepar'd, as before of the Sun, gives 2 for the Quote, and 1 for the Remainder, &c. and the Sun's Place, &c. as in the *Tab'lature*.

THE

The Mean Places of the Moon, Apoge and Node, taken out for *January* the 3*d*, in the Radical Year 1736, as the Year gone back to, is not Leap-Year, are, 10 S. 8 Deg. 43 min. and 6 ſeconds, the Mean Longitude; 10 S. 22 Deg. 7 min. and 57 ſeconds, Apoge; and 6 S. 10 Deg. 18 min. and 15 ſeconds, for the Node.

Next, Againſt 2, the prepar'd Quotient, in the *Table of the Mean Motions*, you have 11 S. 11 Deg. 25 min. and 38 ſeconds, the Moon's Mean Motion, to be ſubtracted (as calculating back) from the Radical Mean Longitude in the Year 1736: But at the ſame time, againſt the prepar'd Remainder, are, 4 S. 9 Deg. 23 min. and 4 ſec. to be added thereto: Their Difference therefore, *viz.* 7 S. 2 Deg. 2 min. and 34 ſeconds, which is Negative, being ſubtracted from the Radical Mean Longitude (as before, of the Sun) gives 3 S. 6 Deg. 40 min. and 52 ſeconds, the Mean Longitude of the Moon *Jan.* 2*d*, 1729, at Noon.

Next, For the ſame reaſon, the Difference of the Mean Motion of the Apoge, againſt 2, the aforeſaid Quotient, and 1, the Remainder, *viz.* 9 S. 14 Deg. 52 min. and 17 ſeconds, which is Negative, being ſubtracted from the aforeſaid Radical Mean Motion of the Apoge, gives 1 S. 7 Deg. 55 min. and 40 ſeconds, the Mean Place thereof, for the ſaid *Jan.* 2*d*, 1729, at Noon.

Next, For the Mean Place of the Node, As in Calculating forward, you always ſubtract; for the ſame back, you muſt always add, the Numbers anſwering to the ſaid Quotient: But thoſe againſt

against the Remainder must always, as in the Anomaly of the Sun, be subtracted: Their difference therefore, which is affirmative, *viz.* 4 S. 15 Deg. 24 min. and 22 seconds, being added to the Radical Place of 1736, *&c.* gives 10 S. 25 Deg. 42 min. and 37 seconds, for the Mean Place thereof also *January* the *2d*, 1729, at Noon.

ENTRING the respective Tables for the First Equation of each, with the Sun's Anomaly, proportion'd, *&c.* you have 3 minutes, 4 seconds, for the Mean Longitude, to be subtracted; 5 minutes, 12 seconds, to be added to that of the Apoge; and 2 minutes, 28 seconds to be subtracted from that of the Node; which gives 3 S. 6 Deg. 37 min. and 48 seconds, Mean Longitude, 1 S. 8 Deg. 0 min. and 52 seconds, Apoge, and 10 S. 25 Deg. 40 min. and 9 seconds, Node, being each of their Places the First time Equated. The Distance of the Apoge, the First time Equated, from the Sun, is, 8 S. 15 Deg. 24 min. with which, entering the *Table of the Second Equatien of the Moon*, you have 1 minute, and 44 seconds Equation, and 10 seconds Increment; which said Increment, by the Sun's Anomaly, as before, will be found to continue the same: Both which, *viz.* 1 min. 54 sec. being therefore subtracted, as the Table directs, from the First equated Place of the Moon, gives 3 S. 6 Deg. 35 min. and 54 seconds, Moon's Place the Second time Equated.

THE Distance of the Node, the First time Equated, from the Sun, is 10 S. 27 Deg. 44 min. and 43 seconds; the Equation answering to which in the *Table of the Third Equation*, is 42 seconds,

to

to be subtracted; which gives 3 S. 6 Deg. 35 min. and 12 seconds, Place of the Moon the Third time Equated.

THE Distance of the Sun from the Moon, the Third time Equated, is, 5 S. 13 Deg. 10 min. and 20 seconds; that of the Apoge of the Sun from the Apoge of the Moon, the First time Equated, is, 9 S. 29 Deg. 53 min. and 23 seconds; both which Sums (the Circle being rejected) make 3 S. 13 Deg. 3 min. and 43 seconds. Against which, in the *Table of the Fourth Equation of the Moon*, are 2 minutes and 21 seconds, to be subtracted from the Third Equated Place of the Moon; which gives her Place, the Fourth time Equated, *viz*. 3 S. 6 Deg. 32 min. and 51 seconds.

IN the *Table of the Second Equation of the Moon's Apoge*, against 8 S. 15 Deg. and 24 min. the Apoge of the Moon, the First time Equated à ☉, proportion'd, *&c.* are 7 Deg. 16 min. and 26 seconds, to be added to the Apoge, the First time Equated, as before; which gives 1 S. 15 Deg. 17 min. and 18 seconds, the Place of the *Apoge* the Second time Equated.

THE Place of the *Apoge* the Second time thus Equated, subtracted from the Place of the Moon, the Fourth time Equated, gives 1 S. 21 Deg. 15 min. and 33 seconds, for the Moon's Mean Anomaly.

IN the *Table of the Moon's Mean Elliptic Equation*, against 1 S. 21 Deg. 15 min. and 33 seconds, Mean Anomaly, are, 4 Deg 45 min. and 13 seconds,

13 seconds, Mean Elliptic Equation, to be subtra-cted. Next, for the *Prosthaphæresis* hereof, in order to reduce it to the True.

The Distance of the *Apoge*, the First time Equated, from the Sun, 6 Signs being rejected, 75 Deg. 24 min. the true prepar'd Degree: For entering the *Table of Reduction of the Mean to the True Elliptic Equation*, in which, against 74, the next less Marginal Number, and under 1 S. 21° at the Head, the next lesser in the Table than the Mean Anomaly, you have 49 min. 28 sec. And at the same time, against 76, the next greater Marginal Number, and under 1 S. 21°, likewise of Anomaly, you have 1′ 54″; their Difference is, 2′ 26″, or 146″ increasing; the Difference between the said lesser Marginal Number, and the True, is, 1 Deg. 24 min. the 24 min. reduc'd to a Decimal, or taken out of the Table, is .4: Whence, the Proportion will be, As 2 (the Difference between the next lesser and greater Marginal Numbers, than the aforesaid prepar'd Degree, &c.) is to the Difference of the Numbers answering to the said greater and lesser Marginal Numbers, *viz.* 146 seconds; so is 1°.4 (the Difference between the next lesser Marginal Number, and the aforesaid prepar'd Degree, &c.) to 102″, or 1′42″, to be added, as it was increasing, to the said 49 min. 28 seconds; which gives 51 min. 10 seconds, the Equation to be subtracted, as the Table directs, from the afore-found Mean Elliptic Equation, *viz.* at 1 S. 21 Deg. Mean Anomaly.

Next,

NEXT, In the said Table, under 1 S. 24 Deg. the next greater than the present Mean Anomaly, against the aforesaid Marginal Numbers, *viz.* 74 and 76, you have 51′ 38″, and 54′ 10″; which order'd and proportion'd, as before *, gives 53′ 24″, to be deducted also from the aforesaid Mean Elliptic Equation, *viz.* at 1 S. 24 Deg. of Mean Anomaly: But the present Mean Anomaly is 1 S. 21 Deg. 15 min. and 33 seconds; the difference between which, and the next lesser in the Table, *viz.* 1 S. 21 Deg. is 15 min. 33 seconds; the Decimal of which, is .26 *fere.* Whence the Proportion will be, As 3 Degrees (the difference between the next lesser and greater Tabular Anomalies, than the present) is to 134 seconds (the difference between 51′ 10″, and 53′ 24″, the Numbers before found, to the said Tabular Anomalies, and the prepar'd Marginal Number;) so is .26 the Decimal of the Difference between the next lesser Tabular Anomaly, and the present Mean Anomaly) to 11 seconds; which, as the Equation is increasing, must be added to 51 min. 10 seconds, answering, as before, to the next lesser Tabular Anomaly, than the present Mean; which gives 51 min. 21 seconds, the True Equation, to be subtracted, as the Table directs, from the Mean Elliptic Equation before found, *viz.* 4 Deg. 45 min. and 13 seconds; which gives 3 Deg. 53 min. and 52 seconds, the True Elliptic Equation requir'd.

* *Vide* Tablet.

X TABLET

T A B L E T.

Dist. Apo. ☽ First time Equated à ☉ prepar'd 75.4°	*Me. Ano.* ☽ 1 S. 21°	*Me. Ano.* ☽ 1 S. 24°
Lesser and Greater Marg. Number than the prepar'd Degree, &c. } 74	0 49 28	0 51 38
76	0 51 54	0 54 10
Differences	2 26	2 32
Ditto in Seconds	146″	152″
Half Diff. tr. prepar'd N° and lesser Marginal N°	Mult. .7	Mult. .7
Products to be added to Numbers agst. less. prep. Marg. N°	102″.2	106″.4
Tr. Eqns. to tr. prep. N° 75.4 —	0 51 10	0 53 24
Diff. ditto *to the gr. and less. Anom.*	2′.14	or ′ .134″
Diff. true and lesser Anomaly (Decim.) .26 $\frac{1}{3}$ *ditto* — —	Mult.	.686
		804
		1072
Equn. to be added to 51′.10, &c.		11″.524
	Tr. Equat.	*Me. Ell. Eqn*
51′ 10″ + 11″ make — —	— 51 21	4 45 43
True Elliptic Equation — —		3 53 52

IF the ſame be requir'd to be prov'd Logarithmically, in the *Table of Conſtant Logarithms*, againſt 8 S. 15 Deg. the next leſſer Number to the preſent Diſt. Apoge of the Moon, the Firſt time Equated à ☉, you have 9.960648; and againſt 8 S. 16 Deg. the next greater, you have 9.960858; their Difference is, 210. Next, the Difference between the aforeſaid next leſſer Number, *viz.* 8 S. 15 Deg. and the True Diſtance of the Moon's *Apoge*, Equated à ☉, *viz.* 8 S. 15 Deg. and 24 minutes, is 24 minutes; the Decimal whereof, .4, multiply'd into 210, the Difference of the aforeſaid two Conſtant Logarithms, as the ſame was increaſing, gives 84; which being added to the leſſer of the aforeſaid *Conſtant Logarithms*, as the ſame was increaſing, gives 9.960732, the *Conſtant Logarithm* in the preſent Example; which, in order to enter the Table with, titled, *An Equation, to be added to half the preſent Mean Anomaly of the Moon*, may be made 9.961. In which Table, againſt the preſent Mean Anomaly, and under the next leſſer Logarithm, (at the Head thereof) than the preſent Conſtant Logarithm, *viz.* 9.957, you have 1′ 5″; and under the next greater, *viz.* 9.962, you have 50″; their difference is 15″ decreaſing. The difference between the next leſſer and next greater Logarithms, than the preſent Conſtant, as before noted, is always 5. Whence the Proportion alſo, as before noted, will always be, As 5 is to the Difference between the next leſſer Tabular Logarithm, and the preſent Conſtant Logarithm; ſo is the Difference of the Equations anſwering to the aforeſaid next leſſer and greater Logarithms, to an Equation to be ſubtracted from that anſwering to the ſaid *leſſer Logarithm*, which gives the True. The difference between the

present Constant Logarithm, *viz.* 9.961, and the next lesser, *viz.* 9.957, is, .4: Whence the Proportion is, As 5 is to 15; so is 4 to 12″; which being subtracted from 1′ 5″, answering as before, to the next lesser Logarithm, gives 53″, to be added, as the Table directs, to half the present Mean Anomaly, *viz.* 25 Deg. 37 min. 46 sec. and an half; which makes 25 Deg. 38 min. 39 seconds and an half; the Tangent of which, *viz.* 9.681304, being added to the Constant Logarithm at first found, gives 9.642036, the Tangent of 23 Deg. 40 min. 50 seconds and an half; which subtracted from the said half Mean Anomaly, *viz.* 25 Deg. 37 min. 46 seconds and an half, gives 1 Deg. 56 min. and 56 seconds; which doubl'd, gives 3 Deg. 53 min. and 52 sec. the True Eliptic Equation requir'd, the same as before; which, as the Table directs, *viz.* when the *Mean Anomaly* of the Moon is under 6 Signs, being subtracted from the Place of the Moon, the Fourth time Equated, *viz.* 3 S. 6 Deg. 32 min. and 51 sec. gives 3 S. 2 Deg. 38 min. and 59 seconds, the Place of the Moon, the Fifth time Equated.

THE Distance of the Sun from the Moon, the Fifth time Equated, will be found to be 5 S. 9 Deg. 14 min. and 7 seconds; with which entring the *Table of the Moon's Variation*, against the same proportion'd, &c. you have 21′ 55″; also 173″ Increment; for the Reduction of which Increment, entering with the Sun's Anomaly, the *Table of Multiplicators*, you have Unity, or so near, that it may be taken for such; by which, multiplying the said Increment, it will remain the same; which being added to 21′ 55″, makes 24′ 48″; which subtracted, as the Table directs, from 3 S. 2 Deg. 38 min. and 59 seconds, the

Place

Place of the Moon, the Fifth time Equated, gives 3 S. 2 Deg. 14 min and 11 sec. the Place of the Moon, the Sixth time Equated.

THE Distance of the Sun from the Moon, the Sixth time Equated, is, 5 S. 8 Deg. 49 min. and 19 sec. Against which, in the *Table of the Seventh Equation*, are, 50 sec. to be subtracted from the Place of the Moon, the Sixth time Equated, *viz.* 3 S. 2 Deg. 14 min. and 11 sec. which gives 3 S. 2 Deg. 13 min. and 21 sec. the Place of the Moon, the Seventh time Equated, and is her Place in her Orbit.

IN the *Table of the Second Equation of the Node*, against 10 S. 27 Deg. 44 min. and 43 sec. the Distance of the Node, the First time Equated from the Sun, you have 1 Deg. 20 min. and 4 sec Equation, to be subtracted from the Place of the Node the First time Equated, *viz.* 10 S. 25 Deg. 40 min. and 9 sec. which gives 10 S. 24 Deg. 23 min. and 5 sec. the true Place of the Node; and at the same time, the Inclination of the Limit will be found to be 12 min. 45 sec.

IN the *Table of Reduction and Excess*, against 4 S. 7 Deg. 53 min. and 17 sec. the Distance of the true Place of the Moon's Node from her Place in her Orbit, you have 6 min. 20 sec. Equation to be added, and 47 seconds Excess, to be proportion'd, *viz.* As 17 min. 45 seconds, the greatest Inclination of the Limit, is to 12 min. 45 sec. the present; so is 47 min. the Tabular Excess, to 34 sec. present Excess, *viz.* Decimally, 12.75 into 47 seconds, into .0568, gives the said 34 seconds *fere*; which being added to the Reduction Equation before found, *viz.* 6 min. 20 sec. gives 6 min. 54 sec. the true Reduction Equation; which added, as the Table directs, to the Place of the Moon

Moon in her Orbit, before found, *viz.* 3 S. 2 Deg. 13 min. and 21 sec. gives 3 S. 2 Deg. 20 min. and 15 sec. the true Place of the Moon in the Ecliptic requir'd.

In the *Table of the Moon's Simple Latitude*, &c. against 4 S. 7 Deg. 53 min. and 16 seconds. the Distance of the Moon's Node from her Place in her Orbit, proportion'd, *&c.* you have 3 Deg. 56 min. and 20 seconds, Simple Latitude North Descending; and at the same time, 13 min. and 57 seconds Increment; which proportion'd, as before in the Excess, *viz.* As 17′ 45″, the greatest Inclination of the Limit, is to 12′ 45″, the present; so is 13′ 57″, the Tabular Increment, to 10′. the present Increment, *viz.* Decimally, 12.75 into 13.95, gives *fere* 178°; and this into .0563, gives 10′, as before; which added to the Simple Latitude before taken out, *viz.* 3 Deg. 56 min. and 19 sec. gives 4 Deg. 6 min. and 19 seconds, the Moon's True Latitude North Descending.

In the *Table of the Eccentricities of the Moon*, against 8 S. 15 Deg. 24 min. the aforesaid Distance of the Moon's *Apoge*, the First time Equated from the Sun, proportion'd, *&c.* as before in the Constant Logarithm, you have .45178, the Eccentricity of the Moon requir'd.

In the *Table of the Moon's Horizontal Parallaxes*, &c. against 1 S. 21 Deg. 15 min. and 33 seconds, Mean Anomaly, proportion'd, *&c.* is 55 min. 56 seconds, answering to the least Horizontal Parallax, and 55 min. 5 seconds, to the greatest: Their difference is, 51 seconds; and the difference between the least Eccentricity, and the present,

present, is, 01855. Therefore, As the Difference between the least and greatest Eccentricities, &c. *viz.* 23454 : 51″ : : 01855 : 4″; which subtracted from 55 min. 56 seconds, gives 55 min. 52 seconds, the True Horizontal Parallax in the Syzygy.

NEXT, Against the Distance of the Sun's True Place, from that of the Moon, in the *Table of the Decimal Multiplicators for the Reduction of the Horizontal Parallax, when out of the Syzygys*, you have .316; by which, multiplying 55′.86, the Horizontal Parallax before-found, the Product (which will be always in Seconds) is 18″ *fere*, to be subtracted from the afore-found Horizontal Parallax in the Syzygy; which gives 55 min. 34 seconds, the present Horizontal Parallax requir'd. The said Horizontal Parallax, 55′.56, multiply'd by .274, gives 15 min. 14 seconds *fere*, for the Moon's Horizontal Semidiameter.

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TABLATURE

TABLATURE *of the Whole* CALCULUS.

1729, Equ. Time.	☉ true Place S. ° ′ ″	☽ Mean Anom. S. ° ′ ″	☉ Apogé. S. ° ′ ″
Jan. 2, Noon.	9 23 24 52	6 14 47 6	3 8 7 29
Equal Time.	☽ Me. Long. S. ° ′ ″	☽ Apogé S. ° ′ ″	☽ Node ☊. S. ° ′ ″
1736.	10 8 43 26	10 22 47 57	6 10 18 15
Ye. 7, *&c.* à *Rad* —	7 2 2 34	— 9 14 52 17	+ 4 15 24 22
1729, *Jan.* 2, Nn.	3 6 40 52	1 7 54 40	10 25 42 22
1*st* Equation —	3 4	+ 5 12	— 2 28
☽ Equd. 1*st* time	3 6 37 48	1 8 0 52	10 25 40 9
2*d* Equation —	1 54	8 15 24 6	10 27 44 43
		.4	☊ Node à ☉
☽ Equd. 2*d* time	3 6 35 54	☽ Apog. à ☉	1 2 0 4
3*d* Equation —	42	2 13 3 44	☊ 2*d Eqn. Node*
		☉ *Ap.* à ☽ *Ap &c*	
☽ Equd. 3*d* time	3 6 35 12	+ 7 16 26	10 24 20 5
4*th* Equation —	2 21	2*d*. Eqn. ☽ Ap.	☽ tr. Pla. Node
			Incl. Lim. 12′45″
☽ Equd. 4*th* time	3 6 32 51	1 15 16 18	4 7 53 16
Elliptic Equat. —	3 55 52	Ap. ☽ 2. ti. Eqd	☊ à ☽ in her *Orb*
		1 21 15 33	Reduct. 6′ 20″
☽ Equd. 5*th* time	3 2 38 59	.26	*TabExc.* 47″ pr. 34″
6*th* Equation —	24 48	☽ Me. Anom.	☽ M. Lt. *No. Desc.* 3° 56′ 20″
☽ Equd. 6*th* time	3 2 13 11	5 9 14 7	
7*th* Equation —	50	☉ à ☽ 5. ti. Eqd	*Tab Increm.* 13.57″
			Present 10′ 0″.
☽ in her Orbit	3 2 13 21	5 1 49 19	Eccen. 45178
Reduct. *&c.* +	6 54	☉ à ☽ 6. ti. Eq*d*.	Hor. Par. 55′34″
			D°. Semid. 15′14″
☽ in Ecliptic.	3 2 20 15		
☽ tr. Lat. *No. Desc.*	4 6 20		

NEW

These two Examples are wrought after the Method in the Astronomy of the Satellites, excepting in the Elliptic and Variation Equations; but that Author having, by an Oversight, made the third Equation additive, where it should be ablative, and the Contrary, which in this last Example being 47″, has occasion'd an Error of double that Quantity, *viz.* 1′ 34″ which said Example is therefore re-computed from the *Chronologer*, with all the Equations of the Theory. *Vide* from *p.* 315. to *p.* 332.

But Observations proving the Theory to be imperfect, and often liable to err, I shall next proceed to the Method specified in the *Preface*, making use of those * Tables, which are digested from the Precepts and Numbers of Mr. *John Machin* at the End of the *English* Edition of Sir *Isaac Newton*'s Principles, and here I shall resume the aforesaid Example, *December* 12, *&c.* 1738. giving a compleat Tablature thereof, as also of the Sun, to clear up all Difficulties that may arise in these Calculations; and here it is to be observed, that by the first Equation of the Moon's Longitude, Apoge, and Node, is to be understood, the Equations of their Annual Mean Motions.

After these Equations are applied, in the aforesaid Example, the Mean Longitude of the Moon † is 2^s 3° 11′ 11″, of the Apoge 2^s 22° 26′ 11″, and the Node 4^s 13° 26′ 5″; † *Vide* Tablature.

* *Vid* pag. 213, 214, 215, 216, Elliptic Equation, and pag. 265.

next the Diſtance of the Apoge from the Sun will be found to be $6^s\ 9^\circ\ 21'\ 55''$, and the ſecond Equation of the Apoge $3^\circ\ 15'\ 36''$ additive, from whence the true Place will be $2^s\ 25^\circ\ 41'\ 47''$, which ſubtracted from $2^s\ 3^\circ\ 11'\ 11''$, the annual or firſt Equated Place of the Moon gives $11^s\ 7^\circ\ 29'\ 24''$ for the Mean Anomaly, to which anſwers $2^\circ\ 17'\ 52''$ Mean Elliptic Equation. Then, with the Anomaly, *viz.* its Complement, as it exceeds 6 Signs, and the prepared Deg. of the Diſtance of the Apoge from the Sun, entring the Table of the Reduction of the Mean to the true Elliptic Equation, by the foregoing Method it will be found to be $24'\ 2''$, to be added to the above Mean Elliptic Equation, which gives $2^\circ\ 41'\ 54''$, the true Elliptic Equation, and which, as the ſaid Table of the Mean Elliptic Equation directs, being added to the Place of the Moon firſt equated, *viz.* $2^s\ 3^\circ\ 11'\ 11''$, gives $2^s\ 5^\circ\ 53'\ 5''$ for the Place of the Moon the ſecond Time equated. From which ſubtract the Place of the Sun, and with the Difference, *viz.* $5^s\ 4^\circ\ 4'\ 59''$ entring the Table of the Variation, proportioned, &c. you will have $28'\ 18''$ to be ſubtracted from the laſt equated Place of the Moon, which gives $2^s\ 5^\circ\ 24'\ 47''$, and is her Place in her Orbit; the Reduction and Exceſs will be found, by the Methods already laid down, to be $5'\ 6''$, to be added to the Orbit-Place, which gives $2^s\ 5^\circ\ 29'\ 53''$, the Place of the Moon in the Ecliptic. The Latitude, Horizontal Parallax, and Semidiameter, will be found the ſame as in the Example before.

The

The Place of the Moon, obtained by the *Chronologer*, which is according to the Theory excepting in the Equant to half Mean Anomaly in the Elliptic Equation) differs from his, which Obfervation has confirmed 4 min. aufing thereby an Error of about 7 min. in Time.

Note, In order to difcover any Typographical Error, or the like, that poffibly may have efcaped Notice in the Tables, take the Differences next above and beneath the Numbers entered the refpective Table with; alfo laterally in the Table of the Reduction of the Mean to the True Elliptic Equation of the Moon, when, if the faid Differences are equal, or nearly fo, you may conclude them to be correct, and by which they may eafily be made fo, if found otherwife.

TABLATURE *of the* CALCULUS.

1736, Equal Time	☉ Me. Long.	☉ Me. Anom.	Eq. ☉ Centre.
	s ° ′ ″ ‴	s ° ′ ″	° ′ ° ′ ″
Dec. 12	9 2 16 17 56	5 24 0 48	5 23 An.—0 14 28
Ho. P.M. 5	12 19 15	12 19	5 24 —0 12 24
Min. 27	1 6 32	1 7	Diff. decr. 0 2 4
	9 2 29 43 43	5 24 14 14	viz. 124
2 Years a Rad.	—28 39 26	—30 41	726
			744
1738, Dec. (&c.) 12	9 2 1 4 17	5 23 43 33	° ′ ″ 248
Eq. ☉ Centre	—12 58 0		0 14 28 868
		.726	0 1 30 90″.024
☉ true Place	9 1 48 6 17		
			0 12 58 Eq. ☉ C.

1738, Equal Time	☽ Me. Long.	☽ Apoge.	☽ Node ☊.
	s ° ′ ″	s ° ′ ″	s ° ′ ″
Dec. (&c.)	2 3 9 51	2 22 28 38	4 13 25 5
Ann. or firſt Equa.	+1 20	—2 27	+1 0
		2 22 26 11	
☽ Equd firſt Time	2 3 11 11		4 13 26 5
Elliptic Equ.	+2 41 54	6 9 21 55	
		37	4 18 22 1
☽ Eq. ſecond Time	2 5 53 5	Apo. a ☉	·37
Variation	—28 18		☊ a ☉.
		+3 15 36	
☽ in her Orbit	2 5 24 47	2d. Equ. Ap.	
Reduc. and Exc.	+5 6	2 25 41 47	—1 28 49
		tr. Pl. Apoge	2d. Equ. ☊.
☽ in Ecliptic	2 5 29 53	11 7 29 24	
			4 11 57 16
☽ tr. Lat. So. Deſc.	4 44 12	.49	tr. Pl. ☊.
		☽ Me. Ano.	

Conſtant Log.		9.942361	0 22 30 36	Incl. Lim. 10 2
° ′ ″				
11 15 18	½ Me. An.		·51	9 23 27 31
+1 23	Equ.		Comp ☽ An.	☊ a ☽ Orbit.
11 16 41	Tangent	9.299772	5 4 4 59	Reduction +4 46
				Tab. Ex. 35″ preſ. 20
9 54 21	Tangent	9.242133	☉ a ☽ : .083	
			2d Ti. eq.	☽ M. Lat. So. Deſc. ° ′ ″ 4 35 1
1 20 57	Diff. à ½ Me. Anom.		Eccent. 06204	
×2			Hor. Par. 53 48	Tab. Incr. 16 17
2 41 54	Ellip. Equation		☽ ½ Dia. 14 44	Preſent 9 11

* The Thirds at the laſt, if under 30, are neglected; if above, a Second is ſubſtited for them.

New and Correct

TABLES

FOR

Calculating the Place of the Sun.

TABLE *of the* SUN's MEAN MOTION *and* ANOMALY *every* Fourth *or* Leap-Year.

These Numbers are the Quotients of the Number of Years from the *Radix, viz.* 1736, divided by 4.

Quotients.	Mean Motion.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	0	0	1	49	17	0	0	2	13
2	0	0	3	38	34	0	0	4	27
3	0	0	5	27	51	0	0	6	40
4	0	0	7	17	8	0	0	8	54
5	0	0	9	6	24	0	0	11	7
6	0	0	10	55	41	0	0	13	20
7	0	0	12	44	58	0	0	15	34
8	0	0	14	34	15	0	0	17	47
9	0	0	16	23	32	0	0	20	0
10	0	0	18	12	49	0	0	22	14
20	0	0	36	25	38	0	0	44	28
30	0	0	54	38	26	0	1	6	42
40	0	1	12	51	15	0	1	28	56
50	0	1	31	4	4	0	1	51	9
60	0	1	49	16	53	0	2	13	24
70	0	2	7	29	42	0	2	35	38
80	0	2	25	42	30	0	2	57	51
90	0	2	43	55	19	0	3	20	5
100	0	3	2	8	8	0	3	42	19
200	0	6	4	16	16	0	7	24	37
300	0	9	6	24	24	0	11	6	56
400	0	12	8	32	32	0	14	49	15
500	0	15	10	40	40	0	18	31	33
600	0	18	12	48	48	0	22	13	52
700	0	21	14	56	56	0	25	56	11
800	0	24	17	5	4	0	29	38	29
900	0	27	19	13	12	1	3	20	28
1000	1	0	21	21	20	1	7	3	7
Remainders, or Years from Leap-Year.	*Subtract*					*Subtract*			
	s	°	′	″	‴	s	°	′	″
1	0	0	14	19	43	0	0	15	20
2	0	0	28	39	26	0	0	30	41
3	0	0	42	59	10	0	0	46	1

Radical

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

JANUARY.

Days	Mean Place.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	9	21	14	15	54	6	12	59	43
2	9	22	13	24	14	6	13	58	51
3	9	23	12	32	34	6	14	57	59
4	9	24	11	40	53	6	15	57	7
5	9	25	10	49	13	6	16	56	15
6	9	26	9	57	33	6	17	55	24
7	9	27	9	5	53	6	18	54	32
8	9	28	8	14	13	6	19	53	40
9	9	29	7	22	32	6	20	52	8
10	10	0	6	30	52	6	21	51	56
11	10	1	5	39	12	6	22	51	5
12	10	2	4	47	32	6	23	50	13
13	10	3	3	55	52	6	24	49	21
14	10	4	3	4	11	6	25	48	29
15	10	5	2	12	31	6	26	47	37
16	10	6	1	20	51	6	27	46	46
17	10	7	0	29	11	6	28	45	54
18	10	7	59	37	31	6	29	45	2
19	10	8	58	45	50	7	0	44	10
20	10	9	57	54	10	7	1	43	18
21	10	10	57	2	30	7	2	42	27
22	10	11	56	10	50	7	3	41	35
23	10	12	55	19	10	7	4	40	43
24	10	13	54	27	29	7	5	39	51
25	10	14	53	35	49	7	6	38	59
26	10	15	52	44	9	7	7	38	8
27	10	16	51	52	29	7	8	37	16
28	10	17	51	1	49	7	9	36	24
29	10	18	50	9	8	7	10	35	32
30	10	19	49	17	28	7	11	34	40
31	10	20	48	25	48	7	12	33	49

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

F E B R U A R Y.

Days	Mean Place.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	10	21	47	34	7	7	13	32	56
2	10	22	46	42	27	7	14	32	4
3	10	23	45	50	47	7	15	31	12
4	10	24	44	59	6	7	16	30	20
5	10	25	44	7	26	7	17	29	28
6	10	26	43	15	46	7	18	28	37
7	10	27	42	24	6	7	19	27	45
8	10	28	41	32	26	7	20	26	53
9	10	29	40	40	45	7	21	26	1
10	11	0	39	49	5	7	22	25	9
11	11	1	38	57	25	7	23	24	18
12	11	2	38	5	45	7	24	23	26
13	11	3	37	14	5	7	25	22	34
14	11	4	36	22	24	7	26	21	42
15	11	5	35	30	44	7	27	20	50
16	11	6	34	39	4	7	28	19	59
17	11	7	33	47	24	7	29	19	7
18	11	8	32	55	44	8	0	18	15
19	11	9	32	4	3	8	1	17	23
20	11	10	31	12	23	8	2	16	31
21	11	11	30	20	43	8	3	15	40
22	11	12	29	29	3	8	4	14	48
23	11	13	28	37	23	8	5	13	56
24	11	14	27	45	42	8	6	13	4
25	11	15	26	54	2	8	7	12	12
26	11	16	26	2	22	8	8	11	20
27	11	17	25	10	42	8	9	10	28
28	11	18	24	19	2	8	9	9	36
29	11	19	23	27	21	8	10	8	44

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1336.

MARCH.

Days.	Mean Place.					Mean Anomaly.			
	s	°	'	"	'''	s	°	'	"
1	11	20	22	35	41	8	12	7	53
2	11	21	21	44	1	8	13	7	1
3	11	22	20	52	21	8	14	6	9
4	11	23	20	0	40	8	15	5	18
5	11	24	19	9	0	8	16	4	26
6	11	25	18	17	20	8	17	3	34
7	11	26	17	25	40	8	18	2	42
8	11	27	16	34	0	8	19	1	50
9	11	28	15	42	19	8	20	0	58
10	11	29	14	50	39	8	21	1	7
11	0	0	13	58	59	8	22	0	15
12	0	1	13	7	19	8	22	59	23
13	0	2	12	15	39	8	23	58	31
14	0	3	11	23	58	8	24	57	39
15	0	4	10	32	18	8	25	56	47
16	0	5	9	40	38	8	26	55	56
17	0	6	8	58	58	8	27	55	4
18	0	7	7	57	18	8	28	54	12
19	0	8	7	5	37	8	29	53	20
20	0	9	6	13	57	9	0	52	28
21	0	10	5	22	17	9	1	51	36
22	0	11	4	30	37	9	2	50	45
23	0	12	3	38	57	9	3	48	53
24	0	13	2	47	16	9	4	48	1
25	0	14	1	55	36	9	5	47	9
26	0	15	1	3	56	9	6	46	17
27	0	16	0	12	16	9	7	45	25
28	0	16	59	20	36	9	8	44	34
29	0	17	58	28	55	9	9	43	42
30	0	18	57	37	15	9	10	42	50
31	0	19	56	45	35	9	11	41	58

Radical

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

A P R I L.

Days.	Mean Place.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	0	20	55	53	53	9	12	41	6
2	0	21	55	2	13	9	13	40	14
3	0	22	54	10	33	9	14	39	22
4	0	23	53	18	52	9	15	38	31
5	0	24	52	27	12	9	16	37	39
6	0	25	51	35	32	9	17	36	47
7	0	26	50	43	52	9	18	35	55
8	0	27	49	52	12	9	19	35	3
9	0	28	49	0	31	9	20	34	11
10	0	29	48	8	51	9	21	33	20
11	1	0	47	17	11	9	22	32	28
12	1	1	46	25	31	9	23	31	36
13	1	2	45	33	51	9	24	30	44
14	1	3	44	42	10	9	25	29	52
15	1	4	43	50	30	9	26	29	0
16	1	5	42	58	50	9	27	28	9
17	1	6	42	7	10	9	28	27	17
18	1	7	41	15	30	9	29	26	25
19	1	8	40	23	49	10	0	25	33
20	1	9	39	32	9	10	1	24	41
21	1	10	38	40	29	10	2	23	49
22	1	11	37	48	49	10	3	22	58
23	1	12	36	57	9	10	4	22	6
24	1	13	36	5	28	10	5	21	14
25	1	14	35	13	48	10	6	20	22
26	1	15	34	22	8	10	7	19	30
27	1	16	33	30	28	10	8	18	38
28	1	17	32	38	48	10	9	17	47
29	1	18	31	47	7	10	10	16	55
30	1	19	30	55	27	10	11	16	3

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

M A Y.

Days.	Mean Place. s	°	′	″	‴	Mean Anomaly. s	°	′	″
1	1	20	30	3	46	10	12	15	11
2	1	21	29	12	6	10	13	14	19
3	1	22	28	20	26	10	14	13	27
4	1	23	27	28	45	10	15	12	36
5	1	24	26	37	5	10	16	11	44
6	1	25	25	45	25	10	17	10	52
7	1	26	24	53	45	10	18	10	0
8	1	27	24	2	5	10	19	9	8
9	1	28	23	10	24	10	20	8	16
10	1	29	22	18	44	10	21	7	25
11	2	0	21	27	4	10	22	6	33
12	2	1	20	35	24	10	23	5	41
13	2	2	19	43	44	10	24	4	49
14	2	3	18	52	3	10	25	3	57
15	2	4	18	0	23	10	26	3	5
16	2	5	17	8	43	10	27	2	14
17	2	6	16	17	3	10	28	1	22
18	2	7	15	25	23	10	29	0	30
19	2	8	14	33	42	10	29	59	38
20	2	9	13	42	2	11	0	58	46
21	2	10	12	50	22	11	1	57	54
22	2	11	11	58	42	11	2	57	3
23	2	12	11	7	2	11	3	56	12
24	2	13	10	15	21	11	4	55	20
25	2	14	9	23	41	11	5	54	28
26	2	15	8	32	1	11	6	53	36
27	2	16	7	40	21	11	7	52	44
28	2	17	6	48	41	11	8	51	53
29	2	18	5	57	0	11	9	51	1
30	2	19	5	5	20	11	10	50	9
31	2	20	4	13	40	11	11	49	17

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.									
J U N E.									
Days.	Mean Place.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	2	21	3	21	59	11	12	48	24
2	2	22	2	30	19	11	13	47	32
3	2	23	1	38	39	11	14	46	40
4	2	24	0	46	58	11	15	45	49
5	2	24	59	55	18	11	16	44	57
6	2	25	59	3	38	11	17	44	5
7	2	26	58	11	58	11	18	43	13
8	2	27	57	20	18	11	19	42	21
9	2	28	56	28	37	11	20	41	29
10	2	29	55	36	57	11	21	40	38
11	3	0	54	45	17	11	22	39	46
12	3	1	53	53	37	11	23	38	54
13	3	2	53	1	57	11	24	38	2
14	3	3	52	10	16	11	25	37	10
15	3	4	51	18	36	11	26	36	18
16	3	5	50	26	56	11	27	35	27
17	3	6	49	35	16	11	28	34	35
18	3	7	48	43	36	11	29	33	43
19	3	8	47	51	55	0	0	32	51
20	3	9	47	0	15	0	1	31	59
21	3	10	46	8	35	0	2	31	7
22	3	11	45	16	55	0	3	30	16
23	3	12	44	25	15	0	4	29	24
24	3	13	43	33	34	0	5	28	32
25	3	14	42	41	54	0	6	27	40
26	3	15	41	50	14	0	7	26	48
27	3	16	40	58	34	0	8	25	56
28	3	17	40	6	54	0	9	25	5
29	3	18	39	15	13	0	10	24	13
30	3	19	38	23	33	0	11	23	21

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

JULY.

Days.	Mean Place.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	3	20	37	31	52	0	12	22	29
2	3	21	36	40	12	0	13	21	37
3	3	22	35	48	32	0	14	20	45
4	3	23	34	56	51	0	15	19	54
5	3	24	34	5	11	0	16	19	2
6	3	25	33	13	31	0	17	18	10
7	3	26	32	21	51	0	18	17	18
8	3	27	31	30	11	0	19	16	26
9	3	28	30	38	30	0	20	15	34
10	3	29	29	46	50	0	21	14	43
11	4	0	28	55	10	0	22	13	51
12	4	1	28	3	30	0	23	12	59
13	4	2	27	11	50	0	24	12	7
14	4	3	26	20	9	0	25	11	15
15	4	4	25	28	29	0	26	10	23
16	4	5	24	36	49	0	27	9	32
17	4	6	23	45	9	0	28	8	40
18	4	7	22	53	29	0	29	7	48
19	4	8	22	1	48	1	0	6	56
20	4	9	21	10	8	1	1	6	4
21	4	10	20	18	28	1	2	5	12
22	4	11	19	26	48	1	3	4	21
23	4	12	18	35	8	1	4	3	29
24	4	13	17	43	27	1	5	2	37
25	4	14	16	51	47	1	6	1	45
26	4	15	16	0	7	1	7	0	53
27	4	16	15	8	27	1	8	0	1
28	4	17	14	16	47	1	8	59	10
29	4	18	13	25	6	1	9	58	18
30	4	19	12	33	26	1	10	57	26
31	4	20	11	41	46	1	11	56	34

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

AUGUST.

Days.	Mean Place.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	4	21	10	50	7	1	12	55	42
2	4	22	9	58	27	1	13	54	50
3	4	23	9	6	47	1	14	53	58
4	4	24	8	15	6	1	15	53	7
5	4	25	7	23	26	1	16	52	15
6	4	26	6	31	46	1	17	51	23
7	4	27	5	40	6	1	18	50	31
8	4	28	4	48	26	1	19	49	39
9	4	29	3	56	45	1	20	48	47
10	5	0	3	5	5	1	21	47	56
11	5	1	2	13	25	1	22	47	4
12	5	2	1	21	45	1	23	46	12
13	5	3	0	30	5	1	24	45	20
14	5	3	59	38	24	1	25	44	28
15	5	4	58	46	44	1	26	43	36
16	5	5	57	55	4	1	27	42	45
17	5	6	57	3	24	1	28	41	53
18	5	7	56	11	44	1	29	41	1
19	5	8	55	20	3	2	0	40	9
20	5	9	54	28	23	2	1	39	17
21	5	10	53	36	43	2	2	38	25
22	5	11	52	45	3	2	3	37	34
23	5	12	51	53	23	2	4	36	42
24	5	13	51	1	42	2	5	35	50
25	5	14	50	10	2	2	6	34	58
26	5	15	49	18	22	2	7	34	6
27	5	16	48	26	42	2	8	33	14
28	5	17	47	35	2	2	9	32	23
29	5	18	46	43	21	2	10	31	31
30	5	19	45	51	41	2	11	30	39
31	5	20	45	0	1	2	12	29	47

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

SEPTEMBER.

Days.	Mean Place. s	°	′	″	‴	Mean Anomaly. s	°	′	″
1	5	21	44	8	18	2	13	28	55
2	5	22	43	16	38	2	14	28	3
3	5	23	42	24	58	2	15	27	11
4	5	24	41	33	17	2	16	26	20
5	5	25	40	41	37	2	17	25	28
6	5	26	39	49	57	2	18	24	36
7	5	27	38	58	17	2	19	23	44
8	5	28	38	6	37	2	20	22	52
9	5	29	37	14	56	2	21	22	0
10	6	0	36	23	16	2	22	21	9
11	6	1	35	31	36	2	23	20	17
12	6	2	34	39	56	2	24	19	25
13	6	3	33	48	16	2	25	18	33
14	6	4	32	56	35	2	26	17	41
15	6	5	32	4	55	2	27	16	49
16	6	6	31	13	15	2	28	15	58
17	6	7	30	21	35	2	29	15	6
18	6	8	29	29	55	3	0	14	14
19	6	9	28	38	14	3	1	13	22
20	6	10	27	46	34	3	2	12	30
21	6	11	26	54	54	3	3	11	38
22	6	12	26	3	14	3	4	10	47
23	6	13	25	11	34	3	5	9	55
24	6	14	24	19	53	3	6	9	3
25	6	15	23	28	13	3	7	8	11
26	6	16	22	36	33	3	8	7	19
27	6	17	21	44	53	3	9	6	27
28	6	18	20	53	13	3	10	5	36
29	6	19	20	1	32	3	11	4	44
30	6	20	19	9	52	3	12	3	52

Radical

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

OCTOBER.

Days.	Mean Place.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	6	21	18	18	11	3	13	3	0
2	6	22	17	26	31	3	14	2	8
3	6	23	16	34	51	3	15	1	16
4	6	24	15	43	10	3	16	0	25
5	6	25	14	51	30	3	16	59	33
6	6	26	13	59	50	3	17	58	41
7	6	27	13	8	10	3	18	57	49
8	6	28	12	16	30	3	19	56	57
9	6	29	11	24	49	3	20	56	5
10	7	0	10	33	9	3	21	55	14
11	7	1	9	41	29	3	22	54	22
12	7	2	8	49	49	3	23	53	30
13	7	3	7	58	9	3	24	52	38
14	7	4	7	6	28	3	25	51	46
15	7	5	6	14	48	3	26	50	54
16	7	6	5	23	8	3	27	50	3
17	7	7	4	31	28	3	28	49	11
18	7	8	3	39	48	3	29	48	19
19	7	9	2	48	7	4	0	47	27
20	7	10	1	56	27	4	1	46	35
21	7	11	1	4	47	4	2	45	43
22	7	12	0	13	7	4	3	44	52
23	7	12	59	21	27	4	4	44	0
24	7	13	58	29	46	4	5	43	8
25	7	14	57	38	6	4	6	42	16
26	7	15	56	46	26	4	7	41	24
27	7	16	55	54	46	4	8	40	32
28	7	17	55	3	6	4	9	39	41
29	7	18	54	11	25	4	10	38	49
30	7	19	53	19	45	4	11	37	57
31	7	20	52	28	5	4	12	37	5

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

NOVEMBER.

Days.	Mean Place.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	7	21	51	36	25	4	13	36	13
2	7	22	50	44	45	4	14	35	21
3	7	23	49	53	5	4	15	34	29
4	7	24	49	1	24	4	16	33	38
5	7	25	48	9	44	4	17	32	46
6	7	26	47	18	4	4	18	31	54
7	7	27	46	26	24	4	19	31	2
8	7	28	45	34	44	4	20	30	10
9	7	29	44	43	3	4	21	29	18
10	8	0	43	51	23	4	22	28	27
11	8	1	42	59	43	4	23	27	35
12	8	2	42	8	3	4	24	26	43
13	8	3	41	16	23	4	25	25	51
14	8	4	40	24	42	4	26	24	59
15	8	5	39	33	2	4	27	24	7
16	8	6	38	41	22	4	28	23	16
17	8	7	37	49	42	4	29	22	24
18	8	8	36	58	2	5	0	21	32
19	8	9	36	6	21	5	1	20	40
20	8	10	35	14	41	5	2	19	48
21	8	11	34	23	1	5	3	18	56
22	8	12	33	31	21	5	4	18	5
23	8	13	32	39	41	5	5	17	13
24	8	14	31	48	0	5	6	16	21
25	8	15	30	56	20	3	7	15	29
26	8	16	30	4	40	5	8	14	37
27	8	17	29	13	0	5	9	13	45
28	8	18	28	21	20	5	10	12	54
29	8	19	27	29	39	5	11	12	2
30	8	20	26	37	59	5	12	11	10

Radical

Radical Mean Places *of the* Sun, *and* Anomaly, *Anno* 1736.

DECEMBER.

Days.	Mean Place.					Mean Anomaly.			
	s	°	′	″	‴	s	°	′	″
1	8	21	25	46	18	5	13	10	18
2	8	22	24	54	38	5	14	9	26
3	8	23	24	2	58	5	15	8	34
4	8	24	23	11	17	5	16	7	43
5	8	25	22	19	37	5	17	6	51
6	8	26	21	27	57	5	18	5	59
7	8	27	20	36	17	5	19	5	7
8	8	28	19	44	37	5	20	4	15
9	8	29	18	52	56	5	21	3	23
10	9	0	18	1	16	5	22	2	32
11	9	1	17	9	36	5	23	1	40
12	9	2	16	17	56	5	24	0	48
13	9	3	15	26	16	5	24	59	56
14	9	4	14	34	35	5	25	59	4
15	9	5	13	42	55	5	26	58	12
16	9	6	12	51	15	5	27	57	21
17	9	7	11	59	35	5	28	56	29
18	9	8	11	7	55	5	29	55	37
19	9	9	10	16	14	6	0	54	45
20	9	10	9	24	34	6	1	53	53
21	9	11	8	32	54	6	2	53	1
22	9	12	7	41	14	6	3	52	10
23	9	13	6	49	34	6	4	51	18
24	9	14	5	57	53	6	5	50	26
25	9	15	5	6	13	6	6	49	34
26	9	16	4	14	33	6	7	48	42
27	9	17	3	22	53	6	8	47	50
28	9	18	2	31	13	6	9	46	59
29	9	19	1	39	32	6	10	46	7
30	9	20	0	47	52	6	11	45	15
31	9	20	59	56	12	6	12	44	23

TABLE *of the* SUN's Mean Motion *and* Anomaly.

Hours.	o	I	II	III	Hours.	o	I	II	III
I	I	II	III	IV	I	I	II	III	IV
II	II	III	IV	V	II	II	III	IV	V
1	0	2	27	51	31	1	16	23	16
2	0	4	55	42	32	1	18	51	7
3	0	7	23	33	33	1	21	18	58
4	0	9	51	24	34	1	23	46	49
5	0	12	19	15	35	1	26	14	40
6	0	14	47	5	36	1	28	42	30
7	0	17	14	56	37	1	31	10	21
8	0	19	42	47	38	1	33	38	12
9	0	22	10	38	39	1	36	6	3
10	0	24	38	29	40	1	38	33	54
11	0	27	6	20	41	1	41	1	45
12	0	29	34	10	42	1	43	29	35
13	0	32	2	1	43	1	45	57	26
14	0	34	29	52	44	1	48	25	17
15	0	36	57	43	45	1	50	53	8
16	0	39	25	34	46	1	53	20	59
17	0	41	53	25	47	1	55	48	50
18	0	44	21	15	48	1	58	16	40
19	0	46	49	6	49	2	0	44	31
20	0	49	16	57	50	2	3	12	22
21	0	51	44	48	51	2	5	40	13
22	0	54	12	39	52	2	8	8	4
23	0	56	40	30	53	2	10	35	55
24	0	59	8	20	54	2	13	3	45
25	1	1	36	11	55	2	15	31	36
26	1	4	4	2	56	2	17	59	27
27	1	6	31	53	57	2	20	27	18
28	1	8	59	44	58	2	22	55	9
29	1	11	27	35	59	2	25	23	0
30	1	13	55	25	60	2	27	50	50

TABLE *for the Equation of the* SUN'*s Centre.*

☉ Ano.	SUBTRACT.									☉ Ano.
Sine.	0			1			2			Sine.
°	°	′	″	°	′	″	°	′	″	°
0	0	0	0	0	57	7	1	39	41	30
1	0	1	59	0	58	51	1	40	42	29
2	0	3	59	1	0	33	1	41	41	28
3	0	5	58	1	2	15	1	42	39	27
4	0	7	57	1	3	55	1	43	35	26
5	0	9	56	1	5	35	1	44	29	25
6	0	11	55	1	7	14	1	45	21	24
7	0	13	53	1	8	51	1	46	11	23
8	0	15	51	1	10	27	1	47	0	22
9	0	17	49	1	12	1	1	47	46	21
10	0	19	47	1	13	35	1	48	31	20
11	0	21	45	1	15	7	1	49	13	19
12	0	23	42	1	16	38	1	49	53	18
13	0	25	38	1	18	7	1	50	32	17
14	0	27	37	1	19	36	1	51	9	16
15	0	29	30	1	21	3	1	51	44	15
16	0	31	25	1	22	28	1	52	17	14
17	0	33	20	1	23	51	1	52	48	13
18	0	35	14	1	25	14	1	53	16	12
19	0	37	8	1	26	35	1	53	43	11
20	0	39	1	1	27	55	1	54	7	10
21	0	40	53	1	29	13	1	54	30	9
22	0	42	44	1	30	29	1	54	50	8
23	0	44	35	1	31	43	1	55	9	7
24	0	46	25	1	32	56	1	55	25	6
25	0	48	14	1	34	8	1	55	39	5
26	0	50	2	1	35	18	1	55	51	4
27	0	51	50	1	36	26	1	56	1	3
28	0	53	36	1	37	33	1	56	9	2
29	0	55	22	1	38	38	1	56	15	1
30	0	57	7	1	39	41	1	56	19	0
Sign.	11			10			9			Sign.
	ADD.									

TABLE *for the Equation of the* SUN's *Centre.*

⊙ *Ano.*	SUBTRACT.									⊙ *Ano.*
Sine.	3			4			5			Sine.
	°	′	″	°	′	″	°	′	″	
0	1	56	19	1	41	48	0	59	15	30
1	1	56	20	1	40	48	0	57	26	29
2	1	56	19	1	39	46	0	55	37	28
3	1	56	16	1	38	41	0	53	48	27
4	1	56	12	1	37	35	0	51	57	26
5	1	56	5	1	36	27	0	50	5	25
6	1	55	56	1	35	17	0	48	13	24
7	1	55	45	1	34	5	0	46	19	23
8	1	55	31	1	32	52	0	44	25	22
9	1	55	15	1	31	37	0	42	30	21
10	1	54	58	1	30	20	0	40	34	20
11	1	54	38	1	29	1	0	38	37	19
12	1	54	16	1	27	41	0	36	40	18
13	1	53	52	1	26	19	0	34	41	17
14	1	53	26	1	24	55	0	32	42	16
15	1	52	58	1	23	30	0	30	43	15
16	1	52	27	1	22	3	0	28	43	14
17	1	51	55	1	20	35	0	26	42	13
18	1	51	20	1	19	5	0	24	41	12
19	1	50	44	1	17	33	0	22	39	11
20	1	50	5	1	16	0	0	20	37	10
21	1	49	24	1	14	26	0	18	34	9
22	1	48	42	1	12	50	0	16	31	8
23	1	47	57	1	11	13	0	14	28	7
24	1	47	11	1	9	34	0	12	24	6
25	1	46	22	1	7	54	0	10	21	5
26	1	45	31	1	6	13	0	8	17	4
27	1	44	38	1	4	31	0	6	13	3
28	1	43	43	1	2	47	0	4	9	2
29	1	42	47	1	1	2	0	2	4	1
30	1	41	48	0	59	15	0	0	0	0
Sign	8			7			6			Sign
	A D D.									

EQUATION *of* TIME, *depending on* SUN's *Anomaly.*

☉ Ano.	SUBTRACT.												☉ Ano.
Sine.	0		1		2		3		4		5		Sine.
	′	″	′	″	′	″	′	″	′	″	′	″	
0	0	0	3	48	6	39	7	45	6	47	3	57	30
1	0	8	3	55	6	43	7	45	6	43	3	50	29
2	0	16	4	2	6	47	7	45	6	39	3	42	28
3	0	24	4	9	6	50	7	45	6	35	3	35	27
4	0	32	4	15	6	54	7	45	6	30	3	28	26
5	0	40	4	22	6	58	7	44	6	26	3	20	25
6	0	48	4	29	7	1	7	44	6	21	3	13	24
7	0	55	4	35	7	5	7	43	6	16	3	5	23
8	1	3	4	42	7	8	7	42	6	11	2	57	22
9	1	11	4	48	7	11	7	41	6	6	2	50	21
10	1	19	4	54	7	14	7	40	6	1	2	42	20
11	1	27	5	0	7	17	7	38	5	56	2	34	19
12	1	35	5	6	7	19	7	37	5	51	2	26	18
13	1	42	5	12	7	22	7	35	5	45	2	18	17
14	1	50	5	18	7	24	7	34	5	40	2	11	16
15	1	58	5	24	7	27	7	32	5	34	2	3	15
16	2	6	5	30	7	29	7	30	5	28	1	55	14
17	2	13	5	35	7	31	7	28	5	22	1	47	13
18	2	21	5	41	7	33	7	25	5	16	1	39	12
19	2	28	5	46	7	35	7	23	5	10	1	30	11
20	2	36	5	52	7	36	7	20	5	4	1	22	10
21	2	41	5	57	7	38	7	17	4	58	1	14	9
22	2	51	6	2	7	39	7	15	4	50	1	6	8
23	2	58	6	7	7	40	7	12	4	45	0	58	7
24	3	6	6	12	7	41	7	9	4	38	0	49	6
25	3	13	6	16	7	42	7	6	4	31	0	41	5
26	3	20	6	21	7	43	7	2	4	25	0	33	4
27	3	27	6	26	7	44	6	59	4	18	0	25	3
28	3	34	6	30	7	45	6	55	4	11	0	16	2
29	3	41	6	34	7	45	6	51	4	4	0	8	1
30	3	48	6	39	7	45	6	47	3	57	0	0	0
Sign.	11		10		9		8		7		6		Sign.
	ADD.												

EQUATION *of* TIME, *depending on the* SUN's *Place.*

SUBTRACT.

Sign.	0	6	1	7	2	8	Sign.
°	′	″	′	″	′	″	°
0	0	0	8	24	8	45	30
1	0	20	8	34	8	35	29
2	0	40	8	44	8	24	28
3	1	0	8	54	8	13	27
4	1	19	9	2	8	1	26
5	1	39	9	10	7	48	25
6	1	59	9	17	7	34	24
7	2	18	9	24	7	20	23
8	2	37	9	30	7	6	22
9	2	57	9	35	6	50	21
10	3	16	9	40	6	35	20
11	3	34	9	44	6	18	19
12	3	52	9	48	6	2	18
13	4	10	9	50	5	44	17
14	4	28	9	52	5	27	16
15	4	46	9	53	5	8	15
16	5	4	9	54	4	50	14
17	5	20	9	54	4	31	13
18	5	37	9	53	4	11	12
19	5	53	9	51	3	52	11
20	6	9	9	49	3	32	10
21	6	25	9	46	3	11	9
22	6	40	9	42	2	51	8
23	6	54	9	38	2	30	7
24	7	9	9	31	2	9	6
25	7	23	9	25	1	48	5
26	7	36	9	19	1	26	4
27	7	48	9	12	1	5	3
28	8	1	9	4	0	43	2
29	8	13	8	55	0	21	1
30	8	24	8	45	0	0	0
Sign.	5	11	4	10	3	9	Sign.

ADD.

EQUATION of TIME, depending on the Sun's Place.

SUBTRACT.

Sign.	0	6	1	7	2	8	Sign.
°	′	″	′	″	′	″	°
0	0	0	8	24	8	45	30
1	0	20	8	34	8	35	29
2	0	40	8	44	8	24	28
3	1	0	8	54	8	13	27
4	1	19	9	2	8	1	26
5	1	39	9	10	7	48	25
6	1	59	9	17	7	34	24
7	2	18	9	24	7	20	23
8	2	37	9	30	7	5	22
9	2	57	9	35	6	50	21
10	3	16	9	40	6	35	20
11	3	34	9	44	6	18	19
12	3	52	9	48	6	2	18
13	4	10	9	50	5	44	17
14	4	28	9	52	5	27	16
15	4	46	9	53	5	8	15
16	5	4	9	54	4	50	14
17	5	20	9	54	4	31	13
18	5	37	9	53	4	11	12
19	5	53	9	51	3	52	11
20	6	9	9	49	3	32	10
21	6	25	9	46	3	11	9
22	6	40	9	42	2	51	8
23	6	54	9	38	2	30	7
24	7	8	9	31	2	9	6
25	7	23	9	25	1	48	5
26	7	36	9	18	1	26	4
27	7	48	9	12	1	5	3
28	8	1	9	4	0	43	2
29	8	13	8	55	0	21	1
30	8	24	8	45	0	0	0
Signs.	5	11	4	10	3	9	Sign.

ADD.

New and Correct

TABLES

FOR

Calculating the Place of the Moon.

New and Correct

TABLES

FOR

Calculating the Place of the Moon.

TABLE *of the* MEAN MOTION *of the* Moon, Apogé, *and* Node, *every* Fourth *or* Leap-Year.

Quotients.	☽ Mean Motion.				Motion Apogé.				Motion Node.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	5	20	42	49	5	12	46	3	2	17	22	3
2	11	11	25	38	10	25	32	7	5	4	44	5
3	5	2	8	27	4	8	18	10	7	22	6	9
4	10	22	51	16	9	21	4	13	10	9	28	12
5	4	13	34	5	3	3	50	15	0	26	50	15
6	10	4	16	54	8	16	36	18	3	14	12	18
7	3	24	59	43	1	29	22	21	6	1	34	21
8	9	15	42	32	7	12	8	25	8	18	56	24
9	3	6	25	21	0	24	54	29	11	6	18	27
10	8	27	8	10	6	7	40	30	1	23	40	31
20	5	24	16	20	0	15	21	0	3	17	21	1
30	2	21	24	30	6	23	1	30	5	11	1	30
40	11	18	32	40	1	0	42	0	7	4	42	1
50	8	15	40	50	7	8	22	30	8	28	22	30
60	5	12	49	0	1	16	3	0	10	22	3	1
70	2	9	57	10	7	23	43	30	0	15	43	21
80	11	17	5	20	2	1	24	0	2	9	24	0
90	8	4	13	30	8	9	4	30	4	3	4	31
100	5	1	21	40	2	16	45	0	5	26	45	0
200	10	2	43	20	5	3	30	0	11	23	30	0
300	3	4	5	0	7	20	15	0	5	20	15	0
400	8	5	16	40	10	7	0	0	11	17	0	0
500	1	6	48	20	0	23	45	0	5	13	45	0
600	6	8	10	0	3	10	30	0	11	10	30	0
700	11	9	31	40	5	27	15	0	5	7	15	0
800	4	10	53	20	8	14	0	0	11	4	0	0
900	9	15	15	0	11	0	45	0	5	0	45	0
1000	2	13	36	40	1	17	30	0	10	27	30	0

These Numbers are the Quotients of the Number of Years from the *Radix, viz.* 1736, divided by 4.

Remainders, or single Years after Leap-Year.	*Add.*				*Add.*				*Subtract*			
	s	°	′	″	s	°	′	″	s	°	′	″
1	4	9	23	4	1	10	39	50	0	19	19	43
2	8	18	46	7	2	21	19	41	1	8	39	26
3	0	28	9	10	4	1	59	32	1	27	59	9

Radical

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.

JANUARY.

Days	Mean Place.				Apogé.				Node ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	9	12	22	16	10	22	34	35	6	10	24	36
2	9	25	32	51	10	22	41	16	6	10	21	26
3	10	8	43	26	10	22	47	57	6	10	18	15
4	10	21	54	1	10	22	54	38	6	10	15	4
5	11	5	4	36	10	23	1	19	6	10	11	54
6	11	18	15	11	10	23	8	0	6	10	8	43
7	0	1	25	46	10	23	14	42	6	10	5	33
8	0	14	36	21	10	23	21	23	6	10	2	22
9	0	27	46	56	10	23	28	4	6	9	59	11
10	1	10	57	31	10	23	34	45	6	9	56	1
11	1	24	8	6	10	23	41	26	6	9	52	50
12	2	7	18	41	10	23	48	7	6	9	49	39
13	2	20	29	16	10	23	54	48	6	9	46	29
14	3	3	39	51	10	24	1	29	6	9	43	18
15	3	16	50	26	10	24	8	10	6	9	40	7
16	4	0	1	1	10	24	14	51	6	9	36	57
17	4	13	11	36	10	24	21	32	6	9	33	46
18	4	26	22	11	10	24	28	13	6	9	30	36
19	5	9	32	46	10	24	34	54	6	9	27	25
20	5	22	43	21	10	24	41	35	6	9	24	14
21	6	5	53	56	10	24	48	17	6	9	21	4
22	6	19	4	31	10	24	54	58	6	9	17	53
23	7	2	15	6	10	25	1	39	6	9	14	42
24	7	15	25	41	10	25	8	20	6	9	11	32
25	7	28	36	16	10	25	15	1	6	9	8	21
26	8	11	46	51	10	25	21	42	6	9	5	10
27	8	24	57	26	10	25	28	23	6	9	2	0
28	9	8	8	1	10	25	35	4	6	8	58	49
29	9	21	18	36	10	25	41	45	6	8	55	38
30	10	4	29	12	10	25	48	26	6	8	52	28
31	10	17	39	47	10	25	55	7	6	8	49	17

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.

F E B R U A R Y.

Days	Mean Place.				Apogé.				Node ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	11	0	50	22	10	26	1	48	6	8	46	7
2	11	14	0	57	10	26	8	29	6	8	42	57
3	11	27	11	32	10	26	15	10	6	8	39	46
4	0	10	22	7	10	26	21	51	6	8	36	35
5	0	23	32	42	10	26	28	32	6	8	33	24
6	1	6	43	17	10	26	35	13	6	8	30	14
7	1	19	53	52	10	26	41	54	6	8	27	3
8	2	3	4	27	10	26	48	35	6	8	23	53
9	2	16	15	2	10	26	55	16	6	8	20	41
10	2	29	25	37	10	27	1	58	6	8	17	31
11	3	12	36	12	10	27	8	39	6	8	14	20
12	3	25	46	47	10	27	15	20	6	8	11	10
13	4	8	57	22	10	27	22	1	6	8	7	59
14	4	22	7	56	10	27	28	42	6	8	4	48
15	5	5	18	31	10	27	35	23	6	8	1	38
16	5	18	29	7	10	27	42	4	6	7	58	27
17	6	1	39	42	10	27	48	45	6	7	55	17
18	6	14	50	17	10	27	55	26	6	7	52	6
19	6	28	0	52	10	28	2	7	6	7	48	55
20	7	11	11	27	10	28	8	48	6	7	45	45
21	7	24	22	2	10	28	15	30	6	7	42	34
22	8	7	32	37	10	28	22	11	6	7	39	24
23	8	20	43	12	10	28	28	52	6	7	36	13
24	9	3	53	47	10	28	35	33	6	7	33	2
25	9	17	4	22	10	28	42	14	6	7	29	52
26	10	0	14	57	10	28	48	55	6	7	26	41
27	10	13	25	32	10	28	55	36	6	7	23	31
28	10	26	36	7	10	29	2	17	6	7	20	20
29	11	9	46	42	10	29	8	58	6	7	17	9
00	00	00	00	00	00	00	00	00	0	0	00	00

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.

MARCH.

Days	Mean Place.				Apogé.				Node ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	11	22	57	17	10	29	15	39	6	7	13	48
2	0	6	7	52	10	29	22	20	6	7	10	48
3	0	19	18	27	10	29	29	1	6	7	7	37
4	1	2	29	2	10	29	35	42	6	7	4	27
5	1	15	39	37	10	29	42	23	6	7	1	16
6	1	28	50	12	10	29	49	5	6	6	58	5
7	2	12	0	47	10	29	55	46	6	6	54	55
8	2	25	11	22	11	0	2	27	6	6	51	44
9	3	8	21	57	11	0	9	8	6	6	48	33
10	3	21	32	32	11	0	15	49	6	6	45	22
11	4	4	43	7	11	0	22	30	6	6	42	11
12	4	17	53	42	11	0	29	11	6	6	39	1
13	5	1	4	17	11	0	35	52	6	6	35	51
14	5	14	14	52	11	0	42	33	6	6	32	40
15	5	27	25	27	11	0	49	14	6	6	29	29
16	6	10	36	2	11	0	55	55	6	6	26	19
17	6	23	46	37	11	1	2	36	6	6	23	8
18	7	6	57	12	11	1	9	17	6	6	19	58
19	7	20	7	48	11	1	15	58	6	6	16	47
20	8	3	18	23	11	1	22	39	6	6	13	36
21	8	16	28	58	11	1	29	21	6	6	10	25
22	8	29	39	33	11	1	36	2	6	6	7	15
23	9	12	50	8	11	1	42	43	6	6	4	4
24	9	26	0	43	11	1	49	24	6	6	0	54
25	10	9	11	18	11	1	56	5	6	5	57	43
26	10	22	21	53	11	2	2	46	6	5	54	32
27	11	5	32	28	11	2	9	27	6	5	51	22
28	11	18	43	3	11	2	16	8	6	5	48	11
29	0	1	53	38	11	2	22	49	6	5	45	0
30	0	15	4	13	11	2	29	30	6	5	41	49
31	0	28	14	48	11	2	36	11	6	5	38	39

Radical Mean Places *of the* Moon, Apogé *and* Node, *Anno* 1736.

APRIL.

Days	Mean Place.				Apogé.				Node ☊			
	s	°	′	″	s	°	′	″	s	°	′	″
1	1	11	25	23	11	2	42	52	6	5	35	28
2	1	24	35	58	11	2	49	33	6	5	32	18
3	2	7	46	33	11	2	56	14	6	5	29	7
4	2	20	57	8	11	3	2	56	6	5	25	56
5	3	4	7	43	11	3	9	37	6	5	22	46
6	3	17	18	19	11	3	16	18	6	5	19	35
7	4	0	28	53	11	3	22	59	6	5	16	25
8	4	13	39	28	11	3	29	40	6	5	13	14
9	4	26	50	3	11	3	36	21	6	5	10	3
10	5	10	0	38	11	3	43	2	6	5	6	53
11	5	23	11	13	11	3	49	43	6	5	3	42
12	6	6	21	48	11	3	56	24	6	5	0	31
13	6	19	32	23	11	4	3	5	6	4	57	21
14	7	2	42	58	11	4	9	46	6	4	54	10
15	7	15	53	33	11	4	16	27	6	4	50	59
16	7	29	4	8	11	4	23	8	6	4	47	49
17	8	12	14	43	11	4	29	49	6	4	44	38
18	8	25	25	18	11	4	36	30	6	4	41	27
19	9	8	35	53	11	4	43	12	6	4	38	16
20	9	21	46	28	11	4	49	53	6	4	35	6
21	10	4	57	3	11	4	56	34	6	4	31	55
22	10	18	7	38	11	5	3	15	6	4	28	45
23	11	1	18	13	11	5	9	56	6	4	25	34
24	11	14	28	48	11	5	16	37	6	4	22	23
25	11	27	39	23	11	5	23	18	6	4	19	13
26	0	10	49	58	11	5	29	59	6	4	16	2
27	0	24	0	33	11	5	36	40	6	4	12	51
28	1	7	11	8	11	5	43	21	6	4	9	41
29	1	20	21	44	11	5	50	2	6	4	6	30
30	2	3	32	18	11	5	56	43	6	4	3	20

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.												
M A Y.												
Days	Mean Place.				Apogé.				Node ☊			
	s	°	′	″	s	°	′	″	s	°	′	″
1	2	16	42	53	11	6	3	24	6	4	0	9
2	2	29	53	28	11	6	10	5	6	3	36	59
3	3	13	4	3	11	6	16	46	6	3	53	48
4	3	26	14	38	11	6	23	28	6	3	50	37
5	4	9	25	13	11	6	30	9	6	3	47	27
6	4	22	35	48	11	6	36	50	6	3	44	16
7	5	5	46	23	11	6	43	31	6	3	41	6
8	5	18	56	58	11	6	50	12	6	3	37	55
9	6	2	7	34	11	6	56	53	6	3	34	44
10	6	15	18	8	11	7	3	34	6	3	31	33
11	6	28	28	44	11	7	10	15	6	3	28	23
12	7	11	39	19	11	7	16	56	6	3	25	13
13	7	24	49	54	11	7	23	37	6	3	22	2
14	8	8	0	29	11	7	30	18	6	3	18	51
15	8	21	11	4	11	7	36	59	6	3	15	41
16	9	4	21	39	11	7	43	40	6	3	12	30
17	9	17	32	14	11	7	50	22	6	3	9	20
18	10	0	42	49	11	7	57	3	6	3	6	9
19	10	13	53	24	11	8	3	44	6	3	2	58
20	10	27	3	59	11	8	10	25	6	2	59	47
21	11	10	14	34	11	8	17	6	6	2	56	37
22	11	23	25	9	11	8	23	47	6	2	53	26
23	0	6	35	44	11	8	30	28	6	2	50	15
24	0	19	46	19	11	8	37	9	6	2	47	4
25	1	2	56	54	11	8	43	50	6	2	43	54
26	1	16	7	29	11	8	50	31	6	2	40	43
27	1	29	18	4	11	8	57	12	6	2	37	33
28	2	12	28	39	11	9	3	53	6	2	34	22
29	2	25	39	14	11	9	10	34	6	2	31	11
30	3	8	49	49	11	9	17	15	6	2	28	1
31	3	22	0	24	11	9	23	57	6	2	24	51

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.

J U N E.

Days	Mean Place.				Apogé.				Node ☊			
	s	°	′	″	s	°	′	″	s	°	′	″
1	4	5	19	59	11	9	30	38	6	2	21	40
2	4	18	21	34	11	9	37	19	6	2	18	29
3	5	1	32	9	11	9	44	0	6	2	15	18
4	5	14	42	44	11	9	50	41	6	2	12	8
5	5	27	53	19	11	9	57	22	6	2	8	57
6	6	11	3	54	11	10	4	3	6	2	5	47
7	6	24	14	29	11	10	10	44	6	2	2	36
8	7	7	25	4	11	10	17	25	6	1	19	25
9	7	20	35	39	11	10	24	6	6	1	56	15
10	8	3	46	14	11	10	30	47	6	1	53	4
11	8	16	56	49	11	10	37	28	6	1	49	53
12	9	0	7	24	11	10	44	9	6	1	46	42
13	9	13	17	59	11	10	50	50	6	1	43	31
14	9	26	28	34	11	10	57	31	6	1	30	21
15	10	9	39	9	11	11	4	13	6	1	37	10
16	10	22	49	44	11	11	10	54	6	1	34	0
17	11	6	0	19	11	11	17	35	6	1	30	49
18	11	19	10	54	11	11	24	16	6	1	27	38
19	0	2	21	29	11	11	30	57	6	1	24	28
20	0	15	32	4	11	11	37	38	6	1	21	17
21	0	28	42	39	11	11	44	19	6	1	18	7
22	1	11	53	14	11	11	51	0	6	1	14	56
23	1	25	3	49	11	11	57	41	6	1	11	45
24	2	8	14	24	11	12	4	22	6	1	8	35
25	2	21	24	59	11	12	11	3	6	1	5	24
26	3	4	35	34	11	12	17	44	6	1	2	13
27	3	17	46	9	11	12	24	25	6	0	59	2
28	4	0	56	45	11	12	31	6	6	0	55	52
29	4	14	7	20	11	12	37	48	6	0	52	41
30	4	27	17	55	11	12	44	29	6	0	49	31
00	0	00	00	00	00	00	00	00	0	0	00	00

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.

JULY.

Days	Mean Place.				Apogé.				Node ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	5	10	28	30	11	12	51	10	6	0	46	20
2	5	23	39	5	11	12	57	51	6	0	43	10
3	6	6	49	40	11	13	4	32	6	0	39	59
4	6	20	0	15	11	13	11	13	6	0	36	48
5	7	3	10	50	11	13	17	54	6	0	33	38
6	7	16	21	25	11	13	24	35	6	0	30	27
7	7	29	32	0	11	13	31	16	6	0	27	17
8	8	12	42	35	11	13	37	57	6	0	24	6
9	8	25	53	10	11	13	44	38	6	0	20	56
10	9	9	3	45	11	13	51	19	6	0	17	45
11	9	22	14	20	11	13	58	0	6	0	14	34
12	10	5	24	55	11	14	4	41	6	0	11	23
13	10	18	35	30	11	14	11	22	6	0	8	12
14	11	1	46	5	11	14	18	3	6	0	5	2
15	11	14	56	40	11	14	24	45	6	0	1	51
16	11	28	7	15	11	14	31	26	5	29	58	41
17	0	11	17	50	11	14	38	7	5	29	55	30
18	0	24	28	25	11	14	44	48	5	29	52	19
19	1	7	39	0	11	14	51	29	5	29	49	8
20	1	20	49	35	11	14	58	9	5	29	45	58
21	2	4	0	10	11	15	4	50	5	29	42	47
22	2	17	10	45	11	15	11	31	5	29	39	36
23	3	0	21	20	11	15	18	13	5	29	36	26
24	3	13	31	55	11	15	24	54	5	29	33	15
25	3	26	42	30	11	15	31	35	5	29	30	5
26	4	9	53	5	11	15	38	16	5	29	26	54
27	4	23	3	40	11	15	44	57	5	29	23	44
28	5	6	14	15	11	15	51	38	5	29	20	33
29	5	19	24	50	11	15	58	19	5	29	17	22
30	6	2	35	25	11	16	5	0	5	29	14	11
31	6	15	46	0	11	16	11	41	5	29	11	0

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.

A U G U S T.

Day.	Mean Place.				Apogé.				Node ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	6	28	56	35	11	16	18	22	5	29	7	49
2	7	12	7	10	11	16	25	3	5	29	4	39
3	7	25	17	45	11	16	31	45	5	29	1	28
4	8	8	28	20	11	16	38	26	5	28	58	18
5	8	21	38	55	11	16	45	7	5	28	55	7
6	9	4	49	30	11	16	51	48	5	28	51	56
7	9	18	0	5	11	16	58	29	5	28	48	45
8	10	1	10	40	11	17	5	10	5	28	45	35
9	10	14	21	15	11	17	11	51	5	28	42	24
10	10	27	31	50	11	17	18	32	5	28	39	14
11	11	10	42	25	11	17	25	13	5	28	36	3
12	11	23	53	0	11	17	31	54	5	28	32	53
13	0	7	3	35	11	17	38	36	5	28	29	42
14	0	20	14	10	11	17	45	17	5	28	26	32
15	1	3	24	45	11	17	51	58	5	28	23	21
16	1	16	35	21	11	17	58	39	5	28	20	11
17	1	29	45	56	11	18	5	20	5	28	17	0
18	2	12	56	31	11	18	12	1	5	28	13	49
19	2	26	7	6	11	18	18	42	5	28	10	39
20	3	9	17	41	11	18	25	23	5	28	7	28
21	3	22	28	16	11	18	32	4	5	28	4	18
22	4	5	38	51	11	18	38	45	5	28	1	7
23	4	18	49	26	11	18	45	26	5	27	57	56
24	5	2	0	1	11	18	52	7	5	27	54	46
25	5	15	10	36	11	18	58	49	5	27	51	35
26	5	28	21	11	11	19	5	30	5	27	48	24
27	6	11	31	46	11	19	12	11	5	27	45	13
28	6	24	42	21	11	19	18	52	5	27	42	3
29	7	7	52	56	11	19	25	33	5	27	38	52
30	7	21	3	31	11	19	32	14	5	27	35	42
31	8	4	14	6	11	19	38	55	5	27	32	31

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.												
SEPTEMBER.												
Days	Mean Place.				Apogé.				Node ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	8	17	24	41	11	19	45	36	5	27	29	20
2	9	0	35	16	11	19	52	17	5	27	26	10
3	9	13	45	51	11	19	58	58	5	27	22	59
4	9	26	56	26	11	20	5	39	5	27	19	49
5	10	10	7	1	11	20	12	20	5	27	16	38
6	10	23	17	36	11	20	19	1	5	27	13	27
7	11	6	28	11	11	20	25	42	5	27	10	16
8	11	19	38	46	11	20	32	23	5	27	7	6
9	0	2	49	21	11	20	39	5	5	27	3	55
10	0	15	59	56	11	20	45	46	5	27	0	44
11	0	29	10	31	11	20	52	27	5	26	57	33
12	1	12	21	6	11	20	59	8	5	26	54	23
13	1	25	31	41	11	21	5	49	5	26	51	12
14	2	8	42	16	11	21	12	30	5	26	48	2
15	2	21	52	51	11	21	19	11	5	26	44	51
16	3	5	3	26	11	21	25	52	5	26	41	40
17	3	18	14	1	11	21	32	33	5	26	38	30
18	4	1	24	36	11	21	39	14	5	26	35	19
19	4	14	35	11	11	21	45	55	5	26	32	9
20	4	27	45	46	11	21	52	36	5	26	28	58
21	5	10	56	21	11	21	59	17	5	26	25	47
22	5	24	6	56	11	22	5	58	5	26	22	37
23	6	7	17	31	11	22	12	39	5	26	19	26
24	6	20	28	6	11	22	19	21	5	26	16	16
25	7	3	38	41	11	22	26	2	5	26	13	5
26	7	16	49	16	11	22	32	43	5	26	9	54
27	7	29	59	51	11	22	39	24	5	26	6	44
28	8	13	10	26	11	22	46	5	5	26	3	33
29	8	26	21	1	11	22	52	46	5	26	0	23
30	9	9	31	36	11	22	59	27	5	25	57	12
00	0	00	00	00	00	00	00	00	0	00	00	00

Radical

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.

O C T O B E R.

Days	Mean Place.				Apogé.				Node ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	9	22	42	11	11	23	6	8	5	25	54	1
2	10	5	52	46	11	23	12	49	5	25	50	51
3	10	19	3	21	11	23	19	30	5	25	47	40
4	11	2	13	56	11	23	26	11	5	25	44	30
5	11	15	24	31	11	23	32	52	5	25	41	19
6	11	28	35	7	11	23	39	33	5	25	38	8
7	0	11	45	42	11	23	46	14	5	25	34	57
8	0	24	56	17	11	13	52	56	5	25	31	47
9	1	8	6	52	11	23	59	37	5	25	28	36
10	1	21	17	27	11	24	6	18	5	25	25	26
11	2	4	28	2	11	24	12	59	5	25	22	15
12	2	17	38	37	11	24	19	40	5	25	19	4
13	3	0	49	12	11	24	26	21	5	25	15	54
14	3	13	59	47	11	24	33	2	5	25	12	43
15	3	27	10	22	11	24	39	43	5	25	9	32
16	4	10	20	57	11	24	46	24	5	25	6	21
17	4	23	31	32	11	24	53	5	5	25	3	11
18	5	6	42	7	11	24	59	46	5	25	0	0
19	5	19	52	42	11	25	6	27	5	24	56	50
20	6	3	3	17	11	25	13	8	5	24	53	39
21	6	16	13	52	11	25	19	49	5	24	50	28
22	6	29	24	27	11	25	26	30	5	24	47	18
23	7	12	35	2	11	25	33	11	5	24	44	7
24	7	25	45	37	11	25	39	52	5	24	40	57
25	8	8	56	12	11	25	46	33	5	24	37	46
26	8	22	6	47	11	25	53	15	5	24	34	35
27	9	5	17	22	11	25	59	56	5	24	31	25
28	9	18	27	57	11	26	6	37	5	24	28	14
29	10	1	38	32	11	26	13	18	5	24	25	4
30	10	14	49	7	11	26	19	59	5	24	21	53
31	10	27	59	42	11	26	26	40	5	24	18	42

Radical Mean Places *of the* Moon, Apogé, *and* Node, *Anno* 1736.

NOVEMBER.

Days	Mean Place.				Apogé.				Node ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	11	11	10	17	11	26	33	21	5	24	15	31
2	11	24	20	52	11	26	40	2	5	24	12	21
3	0	7	31	27	11	26	46	43	5	24	9	10
4	0	20	42	2	11	26	53	24	5	24	5	59
5	1	3	52	37	11	27	0	5	5	24	2	48
6	1	17	3	12	11	27	6	47	5	23	59	38
7	2	0	13	47	11	27	13	28	5	23	56	27
8	2	13	24	22	11	27	20	9	5	23	53	17
9	2	26	34	57	11	27	26	50	5	23	50	6
10	3	9	45	32	11	27	33	31	5	23	46	55
11	3	22	56	7	11	27	40	12	5	23	43	45
12	4	6	6	42	11	27	46	53	5	23	40	34
13	4	19	17	17	11	27	53	34	5	23	37	24
14	5	2	27	52	11	28	0	15	5	23	34	13
15	5	15	38	27	11	28	6	56	5	23	31	2
16	5	28	49	2	11	28	13	37	5	23	27	52
17	6	11	59	37	11	28	20	18	5	23	24	41
18	6	25	10	12	11	28	26	59	5	23	21	31
19	7	8	20	47	11	28	33	40	5	23	18	20
20	7	21	31	22	11	28	40	21	5	23	15	9
21	8	4	41	57	11	28	47	3	5	23	11	58
22	8	17	52	32	11	28	53	44	5	23	8	48
23	9	1	3	7	11	29	0	25	5	23	5	37
24	9	14	13	43	11	29	7	6	5	23	2	26
25	9	27	24	18	11	29	13	47	5	22	59	15
26	10	10	34	53	11	19	20	28	5	22	56	5
27	10	23	45	28	11	29	27	9	5	22	52	54
28	11	6	56	3	11	29	33	50	5	22	49	44
29	11	20	6	38	11	29	40	31	5	22	46	33
30	0	3	17	13	11	29	47	12	5	22	43	22
00	0	00	00	00	00	00	00	00	0	00	00	00

Radical

Radical Mean Places *of the* Moon, Apogé *and* Node, *Anno* 1736.

D E C E M B E R.

Days	Mean Place.				Apogé.				Node ☊			
′	s	°	′	″	s	°	′	″	s	°	′	″
1	0	16	27	48	11	29	53	53	5	22	40	12
2	0	29	38	23	0	0	0	34	5	22	37	1
3	1	12	48	58	0	0	7	15	5	22	33	51
4	1	25	59	33	0	0	13	56	5	22	30	40
5	2	9	10	8	0	0	20	37	5	22	27	29
6	2	22	20	43	0	0	27	18	5	22	24	19
7	3	5	31	18	0	0	34	0	5	22	21	8
8	3	18	41	53	0	0	40	41	5	22	17	58
9	4	1	52	28	0	0	47	22	5	22	14	47
10	4	15	3	3	0	0	54	3	5	22	11	36
11	4	28	13	38	0	1	0	44	5	22	8	26
12	5	11	24	13	0	1	7	25	5	22	5	15
13	5	24	34	48	0	1	14	6	5	22	2	5
14	6	7	45	23	0	1	20	47	5	21	58	54
15	6	20	55	58	0	1	27	28	5	21	55	43
16	7	4	6	33	0	1	34	9	5	21	52	32
17	7	17	17	8	0	1	40	50	5	21	49	22
18	8	0	27	43	0	1	47	32	5	21	46	11
19	8	13	38	18	0	1	54	13	5	21	43	0
20	8	26	48	53	0	2	0	54	5	21	39	49
21	9	9	59	28	0	2	7	35	5	21	36	38
22	9	23	10	3	0	2	14	16	5	21	33	28
23	10	6	20	38	0	2	20	57	5	21	30	17
24	10	19	31	13	0	2	27	38	5	21	27	6
25	11	2	41	48	0	2	34	19	5	21	23	56
26	11	15	52	23	0	2	41	0	5	21	20	45
27	11	29	2	58	0	2	47	41	5	21	17	35
28	0	12	13	33	0	2	54	22	5	21	14	24
29	0	25	24	8	0	3	1	3	5	21	11	14
30	1	8	34	43	0	3	7	44	5	21	8	4
31	1	21	45	19	0	3	14	25	5	21	4	53

TABLE *of the Mean Motion of the* Moon, Apogé, *and* Node, *in Hours, Minutes,* &c.

Hours.	☽			Apoge		Node.	
I	o	I	II	I	II	I	II
II	I	II	III	II	III	II	III
	II	III	IV	III	IV	III	IV
o	o	′	″	′	″	′	″
1	0	32	56	0	17	0	8
2	1	5	53	0	33	0	16
3	1	38	49	0	50	0	24
4	2	11	46	1	7	0	32
5	2	44	42	1	24	0	40
6	3	17	39	1	40	0	48
7	3	50	35	1	57	0	56
8	4	23	32	2	14	1	4
9	4	56	28	2	30	1	12
10	5	29	25	2	47	1	19
11	6	2	21	3	4	1	27
12	6	35	18	3	21	1	35
13	7	8	14	3	37	1	43
14	7	41	10	3	54	1	51
15	8	14	7	4	11	1	59
16	8	47	3	4	27	2	7
17	9	20	0	4	44	2	15
18	9	52	56	5	1	2	23
19	10	25	53	5	18	2	31
20	10	58	49	5	34	2	39
21	11	31	46	5	51	2	47
22	12	4	42	6	8	2	55
23	12	37	39	6	24	3	3
24	13	10	35	6	41	3	11
25	13	43	32	6	58	3	19
26	14	16	28	7	15	3	27
27	14	49	24	7	31	3	34
28	15	22	21	7	48	3	42
29	15	55	17	8	5	3	50
30	16	28	14	8	21	3	58

TABLE *of the Mean Motion of the* Moon, Apogᵉ *and* Node, *in Hours, Minutes, &c. continued.*

Hours. I II	☽ ° I II	☽ I II III	☽ II III IV	Apogé. I II III	Apogé. II III IV	Node. I II III	Node. II III IV
	°	′	″	′	″	′	″
31	17	1	10	8	38	4	6
32	17	34	7	8	54	4	14
33	18	7	3	9	11	4	22
34	18	39	59	9	28	4	30
35	19	12	55	9	45	4	38
36	19	45	52	10	2	4	46
37	20	18	48	10	19	4	54
38	20	51	45	10	36	5	2
39	21	24	41	10	52	5	10
40	21	57	38	11	8	5	18
41	22	30	34	11	25	5	26
42	23	3	31	11	42	5	34
43	23	36	27	11	59	5	42
44	24	9	24	12	16	5	50
45	24	42	20	12	32	5	58
46	25	15	17	12	48	6	6
47	25	48	13	13	5	6	14
48	26	21	10	13	22	6	22
49	26	54	6	13	39	6	30
50	27	27	3	13	56	6	38
51	27	59	59	14	13	6	46
52	28	32	56	14	30	6	54
53	29	5	52	14	46	7	1
54	29	38	49	15	2	7	8
55	30	11	45	15	19	7	16
56	30	44	42	15	36	7	24
57	31	17	38	15	53	7	32
58	31	50	34	16	10	7	40
59	32	23	31	16	26	7	48
60	32	56	27	16	43	7	56

TABLE of the First Equation of the MOON.
(According to Sir ISAAC NEWTON)

☉ Me. Ano.	ADD.												☉ Me. Ano.
Sign.	0		1		2		3		4		5		Sign.
	′	″	′	″	′	″	′	″	′	″	′	″	
0	0	0	5	48	10	7	11	49	10	20	6	1	30
1	0	12	5	59	10	14	11	49	10	14	5	50	29
2	0	24	6	9	10	20	11	49	10	8	5	39	28
3	0	36	6	19	10	26	11	49	10	1	5	28	27
4	0	48	6	29	10	31	11	48	9	55	5	16	26
5	1	1	6	40	10	37	11	47	9	48	5	5	25
6	1	13	6	50	10	42	11	46	9	41	4	54	24
7	1	25	7	0	10	47	11	45	9	33	4	42	23
8	1	37	7	10	10	52	11	44	9	26	4	30	22
9	1	49	7	19	10	57	11	42	9	18	4	19	21
10	2	0	7	28	11	1	11	41	9	11	4	7	20
11	2	12	7	38	11	6	11	39	9	2	3	55	19
12	2	24	7	47	11	9	11	36	8	54	3	43	18
13	2	36	7	56	11	14	11	34	8	46	3	31	17
14	2	48	8	5	11	18	11	31	8	37	3	19	16
15	3	0	8	14	11	21	11	29	8	29	3	7	15
16	3	11	8	23	11	24	11	25	8	20	2	55	14
17	3	23	8	31	11	27	11	22	8	11	2	43	13
18	3	35	8	39	11	30	11	19	8	2	2	30	12
19	3	46	8	48	11	33	11	15	7	53	2	18	11
20	3	58	8	56	11	35	11	11	7	43	2	5	10
21	4	9	9	4	11	38	11	7	7	34	1	53	9
22	4	20	9	11	11	40	11	2	7	24	1	41	8
23	4	32	9	19	11	42	10	58	7	14	1	28	7
24	4	43	9	26	11	43	10	53	7	4	1	15	6
25	4	54	9	34	11	46	10	48	6	54	1	3	5
26	5	5	9	41	11	47	10	43	6	43	0	50	4
27	5	16	9	48	11	47	10	38	6	33	0	38	3
28	5	27	9	54	11	48	10	32	6	22	0	25	2
29	5	37	10	1	11	48	10	26	6	12	0	12	1
30	5	48	10	7	11	49	10	20	6	1	0	0	0
Sign.	11		10		9		8		7		6		Sign.
☉ M.A.	SUBTRACT.												☉ M.A.

TABLE *of the First Equation of the* MOON'S APOGE.
(*According to Sir* ISAAC NEWTON.)

⊙ M.A.	SUBTRACT.												⊙ M.A.
Sign.	0		1		2		3		4		5		Sign.
	′	″	′	″	′	″	′	″	′	″	′	″	
0	0	0	9	49	17	8	20	0	17	30	10	11	30
1	0	20	10	7	17	19	20	0	17	20	9	52	29
2	0	40	10	24	17	29	20	0	17	9	9	34	28
3	1	1	10	42	17	39	19	59	16	58	9	15	27
4	1	22	10	59	17	48	19	59	16	46	8	56	26
5	1	42	11	16	17	58	19	57	16	35	8	37	25
6	2	3	11	33	18	7	19	56	16	23	8	17	24
7	2	23	11	50	18	16	19	54	16	11	7	58	23
8	2	43	12	6	18	24	19	52	15	58	7	38	22
9	3	4	12	23	18	32	19	49	15	45	7	18	21
10	3	24	12	39	18	39	19	46	15	32	6	58	20
11	3	44	12	55	18	46	19	42	15	18	6	38	19
12	4	4	13	10	18	53	9	39	15	4	6	18	18
13	4	24	13	26	19	0	19	35	14	50	5	58	17
14	4	45	13	41	19	6	19	30	14	36	5	38	16
15	5	4	13	56	19	12	19	25	14	21	5	17	15
16	5	24	14	11	19	18	19	20	14	6	4	56	14
17	5	44	14	25	19	23	19	14	13	51	4	35	13
18	6	4	14	39	19	28	19	8	13	36	4	15	12
19	6	23	14	53	19	33	19	2	13	20	3	54	11
20	6	43	15	7	19	37	18	55	13	4	3	33	10
21	7	2	15	21	19	41	18	48	12	48	3	12	9
22	7	21	15	33	19	44	18	41	12	31	2	51	8
23	7	40	15	46	19	48	18	33	12	15	2	30	7
24	7	59	15	59	19	51	18	25	11	58	2	8	6
25	8	18	16	11	19	53	18	18	11	41	1	46	5
26	8	36	16	23	19	55	18	8	11	23	2	25	4
27	8	54	16	35	19	57	17	59	11	5	1	4	3
28	9	13	16	46	19	58	17	50	10	47	0	43	2
29	9	31	16	57	19	59	17	40	10	30	0	21	1
30	9	49	17	8	20	0	17	30	10	11	0	0	0
Sign.	11		10		9		8		7		6		Sign.
⊙ M.A.	ADD.												⊙ M.A.

TABLE *of the First Equation of the* Moon's Node.
(*According to Sir* Isaac Newton.)

☉ Me. Ano.	ADD.												☉ Me. Ano.
Sign.	0		1		2		3		4		5		Sign.
	′	″	′	″	′	″	′	″	′	″	′	″	
0	0	0	4	40	8	8	9	30	8	19	4	50	30
1	0	9	4	48	8	14	9	30	8	14	4	41	29
2	0	19	4	57	8	18	9	30	8	9	4	32	28
3	0	29	5	5	8	24	9	30	8	4	4	23	27
4	0	39	5	13	8	28	9	29	7	58	4	14	26
5	0	49	5	21	8	32	9	29	7	53	4	5	25
6	0	58	5	29	8	36	9	28	7	48	3	56	24
7	1	8	5	37	8	40	9	27	7	41	3	47	23
8	1	18	5	45	8	44	9	26	7	35	3	38	22
9	1	27	5	53	8	48	9	25	7	29	3	28	21
10	1	37	6	0	8	52	9	24	7	23	3	19	20
11	1	47	6	8	8	55	9	22	7	16	3	9	19
12	1	56	6	15	8	58	9	20	7	10	3	0	18
13	2	6	6	23	9	2	9	18	7	3	2	50	17
14	2	15	6	30	9	5	9	16	6	56	2	40	16
15	2	25	6	37	9	7	9	14	6	49	2	30	15
16	2	34	6	44	9	10	9	11	6	42	2	20	14
17	2	43	6	51	9	12	9	8	6	35	2	11	13
18	2	53	6	58	9	15	9	6	6	27	2	1	12
19	3	2	7	4	9	17	9	3	6	20	1	51	11
20	3	11	7	11	9	19	9	59	6	12	1	40	10
21	3	20	7	17	9	21	8	56	6	5	1	31	9
22	3	29	7	23	9	23	8	53	6	56	1	21	8
23	3	39	7	29	9	24	8	49	5	49	1	11	7
24	3	47	7	35	9	26	8	45	5	41	1	1	6
25	3	56	7	41	9	26	8	41	5	33	0	51	5
26	4	5	7	47	9	28	8	37	5	24	0	41	4
27	4	14	7	52	9	28	8	33	5	16	0	30	3
28	4	23	7	58	9	29	8	28	5	8	0	20	2
29	4	31	8	3	9	29	8	23	4	59	0	10	1
30	4	40	8	8	9	30	8	19	4	50	0	0	0
Sign.	11		10		9		8		7		6		Sign.
	SUBTRACT.												

ner.

n's Node.

5	⊙ Me. Ano. Sign.
"	
50	30
41	29
32	28
23	27
14	26
5	25
56	24
47	23
38	22
28	21
19	20
9	19
0	18
50	17
40	16
30	15
20	14
11	13
1	12
51	11
40	10
31	9
21	8
11	7
1	6
51	5
41	4
30	3
20	2
10	1
0	0
6	Sign.

TABLE *of the Second Equation of the* MOON.
(*According to Sir* ISAAC NEWTON.)

SUBTRACT.

☽ *Apo. à* ☉	Signs. 0	6	Incre-ment.	Signs. 1	7	Incre-ment.	Signs. 2	8	Incre-ment.	☽ *Apo. à* ☉
	′	″	″	′	″	″	′	″	″	
0	0	0	0	3	5	19	3	5	19	30
1	0	7	1	3	9	19	3	1	19	29
2	0	15	1	3	12	20	2	57	18	28
3	0	22	2	3	15	20	2	53	18	27
4	0	30	3	3	18	20	2	49	17	26
5	0	37	4	3	21	21	2	44	17	25
6	0	45	4	3	24	21	2	39	16	24
7	0	52	5	3	26	21	2	34	16	23
8	0	59	6	3	28	21	2	29	15	22
9	1	6	7	3	29	21	2	23	15	21
10	1	13	8	3	31	22	2	18	14	20
11	1	20	8	3	32	22	2	12	14	19
12	1	27	9	3	33	22	2	6	13	18
13	1	34	10	3	33	22	2	0	12	17
14	1	40	10	3	34	22	1	53	12	16
15	1	47	11	3	34	22	1	47	11	15
16	1	53	12	3	34	22	1	40	10	14
17	2	0	12	3	33	22	1	34	10	13
18	2	6	13	3	33	22	1	27	9	12
19	2	12	14	3	32	22	1	20	8	11
20	2	18	14	3	31	22	1	13	8	10
21	2	23	15	3	29	21	1	6	7	9
22	2	29	15	3	28	21	0	59	6	8
23	2	34	16	3	26	21	0	52	5	7
24	2	39	16	3	24	21	0	45	4	6
25	2	44	17	3	21	21	0	37	4	5
26	2	49	17	3	18	20	0	30	3	4
27	2	53	18	3	15	20	0	22	2	3
28	2	57	18	3	12	20	0	15	1	2
29	3	1	19	3	9	19	0	7	1	1
30	3	5	19	3	5	19	0	0	0	0
Sign.	11	5		10	4		9	3		Sign.

ADD.

Decimal Multipliers *to the* **Increment** *in the Second Equation Table of* ☽.

☉ Mean Anomaly. Sign.	0	1	2	3	4	5	☉ Mean Anomaly. Sign.
° 0	.000	.068	.273	.5	.773	.955	30
1	.002	.072	.28	.508	.780	.957	29
2	.004	.076	.288	.515	.789	.96	28
3	.006	.08	.296	.523	.795	.962	27
4	.008	.084	.303	.53	.803	.965	26
5	.01	.087	.311	.538	.811	.967	25
6	.011	.091	.318	.545	.818	.97	24
7	.013	.098	.326	.553	.822	.972	23
8	.015	.106	.333	.561	.826	.975	22
9	.017	.114	.341	.568	.83	.977	21
10	.019	.121	.348	.576	.833	.98	20
11	.021	.129	.356	.583	.837	.982	19
12	.023	.136	.364	.591	.841	.985	18
13	.025	.144	.371	.599	.845	.987	17
14	.027	.152	.379	.606	.848	.99	16
15	.029	.159	.386	.614	.852	.992	15
16	.031	.167	.394	.621	.856	.995	14
17	.032	.174	.401	.629	.86	.997	13
18	.034	.182	.409	.636	.864	1.—	12
19	.036	.189	.417	.648	.871	1.—	11
20	.038	.197	.424	.659	.879	1.—	10
21	.04	.205	.432	.671	.886	1.—	9
22	.042	.212	.439	.682	.894	1.—	8
23	.044	.22	.447	.693	.901	1.—	7
24	.046	.227	.455	.705	.909	1.—	6
25	.049	.235	.462	.716	.917	1.—	5
26	.052	.243	.47	.728	.924	1.—	4
27	.057	.25	.477	.739	.932	1.—	3
28	.061	.258	.485	.75	.939	1.—	2
29	.065	.265	.492	.762	.947	1.—	1
30	.068	.273	.5	.773	.955	1.—	0
Sign.	11	10	9	8	7	6	Sign.

☉ Mean Anomaly.

TABLE *of the Third Equation of the* MOON.
(*According to Sir* ISAAC NEWTON.)

SUB.

☉ à ☊ ☽	ADD.			☉ à ☊ ☽
	Signs. 0 6	Signs. 1 7	Signs. 2 8	
°	"	"	"	°
0	0	41	41	30
1	2	41	40	29
2	3	42	39	28
3	5	43	38	27
4	6	44	37	26
5	8	44	36	25
6	10	45	35	24
7	11	45	34	23
8	13	46	33	22
9	15	46	31	21
10	16	46	30	20
11	18	47	29	19
12	19	47	27	18
13	20	47	26	17
14	22	47	25	16
15	23	47	23	15
16	25	47	22	14
17	26	47	20	13
18	27	47	19	12
19	29	47	18	11
20	30	46	16	10
21	31	46	15	9
22	33	46	13	8
23	34	45	11	7
24	35	45	10	6
25	36	44	8	5
26	37	44	6	4
27	38	43	5	3
28	39	42	3	2
29	40	41	2	1
30	41	41	0	0
Sign.	11 5	10 4	9 3	Sign.
	SUBTRACT.			

ADD.

TABLE *of the Fourth Equation of the* MOON.
(According to Sir ISAAC NEWTON*)*

	☉ à ☽ +						
	☉ Apo. à ☽ Apo.						
Sign.	0	S.	1	S.	2	S.	Sign.
Sign.	6	A.	7	A.	8	A.	Sign.
°	′	″	′	″	′	″	°
0	0	0	1	12	2	5	30
1	0	2	1	15	2	7	29
2	0	5	1	17	2	8	28
3	0	7	1	19	2	9	27
4	0	10	1	21	2	10	26
5	0	12	1	23	2	11	25
6	0	15	1	25	2	12	24
7	0	17	1	27	2	13	23
8	0	20	1	29	2	14	22
9	0	22	1	31	2	15	21
10	0	25	1	33	2	16	20
11	0	27	1	35	2	17	19
12	0	30	1	37	2	17	18
13	0	32	1	39	2	18	17
14	0	35	1	41	2	19	16
15	0	37	1	43	2	20	15
16	0	40	1	44	2	20	14
17	0	42	1	46	2	21	13
18	0	44	1	48	2	21	12
19	0	46	1	49	2	22	11
20	0	49	1	51	2	22	10
21	0	51	1	52	2	23	9
22	0	54	1	54	2	23	8
23	0	56	1	55	2	24	7
24	0	59	1	57	2	24	6
25	1	1	1	58	2	24	5
26	1	3	2	0	2	24	4
27	1	5	2	1	2	25	3
28	1	8	2	3	2	25	2
29	1	10	2	4	2	25	1
30	1	12	2	5	2	25	0
Sign.	11	A.	10	A.	9	A.	Sign.
Sign.	5	S.	4	S.	3	S.	Sign.

TABLE *of the Second Equation of the* MOON's *Apogé.*
(According to Sir ISAAC NEWTON.*)*

☽ *Apo. à* ☉	ADD.									☽ *Apo. à* ☉
	Signs. 0		6	Signs. 1		7	Signs. 2		8	
°	°	′	″	°	′	″	°	′	″	°
0	0	0	0	9	27	57	11	40	0	30
1	0	21	4	9	42	12	11	30	39	29
2	0	42	8	9	55	58	11	20	14	28
3	1	3	10	10	9	14	11	8	44	27
4	1	24	9	10	21	58	10	56	8	26
5	1	45	5	10	34	9	10	42	26	25
6	2	5	57	10	45	47	10	27	38	24
7	2	26	44	10	56	49	10	11	45	23
8	2	47	25	11	7	15	9	54	47	22
9	3	8	0	11	17	4	9	36	44	21
10	3	28	27	11	26	14	9	17	37	20
11	3	48	46	11	34	43	8	57	25	19
12	4	8	55	11	42	31	8	36	11	18
13	4	28	54	11	49	36	8	13	56	17
14	4	48	42	11	55	57	7	50	42	16
15	5	8	19	12	1	33	7	26	29	15
16	5	27	43	12	6	22	7	1	21	14
17	5	46	53	12	10	23	6	35	19	13
18	6	5	46	12	13	35	6	8	26	12
19	6	24	27	12	15	56	5	40	45	11
20	6	42	50	12	17	24	5	12	18	10
21	7	0	56	12	17	59	4	43	10	9
22	7	18	44	12	17	40	4	13	23	8
23	7	36	12	12	16	25	3	43	1	7
24	7	53	20	12	14	13	3	12	9	6
25	8	10	6	12	11	2	2	40	49	5
26	8	26	29	12	6	52	2	9	7	4
27	8	42	29	12	1	42	1	37	6	3
28	8	58	5	11	55	31	1	4	52	2
29	9	13	15	11	48	17	0	32	28	1
30	9	27	57	11	40	0	0	0	0	0
Sign.	11		5	10		4	9		3	Sign.
	SUBTRACT.									

TABLE *of the First Equation of the* MOON.
(*According to Mr.* MACHIN.)

⊙ Me. Ano.	ADD.												⊙ Me. Ano.
Sign.	0		1		2		3		4		5		Sign.
°	′	″	′	″	′	″	′	″	′	″	′	″	°
0	0	0	5	56	10	22	12	6	10	35	6	10	30
1	0	12	6	7	10	28	12	6	10	29	5	58	29
2	0	25	6	18	10	35	12	6	10	23	5	47	28
3	0	37	6	28	10	41	12	5	10	16	5	35	27
4	0	50	6	39	10	46	12	5	10	9	5	24	26
5	1	2	6	49	10	52	12	4	10	2	5	13	25
6	1	14	7	0	10	57	12	3	9	55	5	1	24
7	1	27	7	10	11	3	12	2	9	48	4	49	23
8	1	39	7	20	11	8	12	1	9	40	4	37	22
9	1	51	7	29	11	12	11	59	9	32	4	25	21
10	2	3	7	39	11	17	11	57	9	24	4	13	20
11	2	16	7	49	11	22	11	55	9	16	4	1	19
12	2	28	7	58	11	26	11	53	9	7	3	49	18
13	2	40	8	7	11	30	11	51	8	59	3	36	17
14	2	52	8	17	11	34	11	48	8	50	3	24	16
15	3	4	8	26	11	37	11	45	8	41	3	12	15
16	3	16	8	35	11	41	11	42	8	32	2	59	14
17	3	28	8	43	11	44	11	38	8	23	2	47	13
18	3	40	8	52	11	47	11	35	8	14	2	34	12
19	3	52	9	0	11	50	11	31	8	4	2	21	11
20	4	3	9	9	11	52	11	27	7	54	2	9	10
21	4	15	9	17	11	54	11	23	7	44	1	56	9
22	4	27	9	25	11	57	11	18	7	34	1	43	8
23	4	38	9	32	11	59	11	14	7	24	1	30	7
24	4	50	9	40	12	0	11	9	7	14	1	17	6
25	5	1	9	47	12	2	11	4	7	4	1	5	5
26	5	12	9	55	12	3	10	58	6	53	0	52	4
27	5	23	10	2	12	4	10	53	6	43	0	39	3
28	5	34	10	9	12	5	10	47	6	32	0	26	2
29	5	45	10	15	12	5	10	41	6	21	0	13	1
30	5	56	10	22	12	6	10	35	6	10	0	0	0
Sign.	11		10		9		8		7		6		Sign.
⊙ M.A.	SUBTRACT.												⊙ M.A.

TABLE *of the First Equation of the* Moon's Apogé.
(*According to Mr.* Machin.)

☉ M.A.	SUBTRACT.												☉ M.A.
Sign.	0		1		2		3		4		5		Sign.
°	′	″	′	″	′	″	′	″	′	″	′	″	°
0	0	0	10	47	18	48	21	56	19	12	11	11	30
1	0	22	11	6	19	0	21	57	19	1	10	50	29
2	0	44	11	25	19	11	21	56	18	49	10	30	28
3	1	7	11	44	19	22	21	56	18	37	10	9	27
4	1	30	12	3	19	33	21	56	18	24	9	48	26
5	1	52	12	22	19	43	21	54	18	11	9	27	25
6	2	14	12	41	19	54	21	52	17	58	9	6	24
7	2	37	12	59	20	2	21	50	17	45	8	45	23
8	2	59	13	18	20	11	21	46	17	31	8	23	22
9	3	22	13	36	20	20	21	44	17	17	8	1	21
10	3	44	13	53	20	28	21	42	17	3	7	39	20
11	4	6	14	10	20	36	21	38	16	48	7	17	19
12	4	28	14	27	20	44	21	34	16	33	6	55	18
13	4	50	14	44	20	51	21	29	16	17	6	33	17
14	5	13	15	1	20	58	21	24	16	1	6	10	16
15	5	34	15	18	21	4	21	19	15	45	5	48	15
16	5	56	15	35	21	11	21	13	15	29	5	25	14
17	6	17	15	49	21	17	21	7	15	12	5	2	13
18	6	39	16	5	21	22	21	0	14	55	4	39	12
19	7	0	16	20	21	27	20	54	14	38	4	16	11
20	7	22	16	35	21	32	20	46	14	20	3	53	10
21	7	43	16	50	21	36	20	38	14	2	3	30	9
22	8	4	17	4	21	40	20	30	13	44	3	7	8
23	8	25	17	18	21	43	20	22	13	26	2	44	7
24	8	45	17	32	21	46	20	13	13	7	2	20	6
25	9	5	17	46	21	49	20	4	12	48	1	57	5
26	9	26	17	59	21	52	19	54	12	29	1	34	4
27	9	47	18	11	21	53	19	44	12	10	1	11	3
28	10	7	18	24	21	54	19	34	11	50	0	47	2
29	10	27	18	36	21	56	19	23	11	31	0	21	1
30	10	47	18	48	21	56	19	12	11	11	0	0	0
Sign.	11		10		9		8		7		6		Sign.
☉ M.A.	ADD.												☉ M.A.

TABLE *of the First Equation of the* MOON's *Node* ☊.
(*According to Mr* MACHIN.)

☉ Me. Ano.	ADD.												☉ Me. Ano.
Sign.	0		1		2		3		4		5		Sign.
°	′	″	′	″	′	″	′	″	′	″	′	″	°
0	0	0	4	23	7	39	8	56	7	49	4	33	30
1	0	9	4	31	7	44	8	56	7	44	4	25	29
2	0	18	4	39	7	48	8	56	7	39	4	16	28
3	0	28	4	47	7	53	8	56	7	34	4	7	27
4	0	37	4	54	7	57	8	55	7	30	3	58	26
5	0	46	5	2	8	2	8	55	7	24	3	51	25
6	0	55	5	10	8	6	8	54	7	19	3	42	24
7	1	4	5	17	8	10	8	53	7	13	3	33	23
8	1	13	5	25	8	13	8	52	7	7	3	24	22
9	1	22	5	32	8	17	8	51	7	1	3	16	21
10	1	31	5	39	8	20	8	50	6	56	3	7	20
11	1	40	5	46	8	23	8	48	6	50	2	58	19
12	1	49	5	53	8	26	8	46	6	44	2	49	18
13	1	58	6	0	8	29	8	44	6	38	2	40	17
14	2	7	6	7	8	32	8	42	6	31	2	31	16
15	2	16	6	13	8	35	8	40	6	25	2	22	15
16	2	25	6	20	8	37	8	38	6	18	2	13	14
17	2	34	6	26	8	40	8	36	6	11	2	3	13
18	2	42	6	33	8	42	8	33	6	4	1	54	12
19	2	51	6	39	8	44	8	30	5	57	1	45	11
20	3	0	6	45	8	46	8	27	5	50	1	35	10
21	3	8	6	51	8	48	8	24	5	43	1	25	9
22	3	17	6	57	8	49	8	21	5	36	1	15	8
23	3	25	7	3	8	50	8	18	5	28	1	6	7
24	3	34	7	8	8	52	8	14	5	20	0	57	6
25	3	42	7	14	8	53	8	10	5	12	0	47	5
26	3	51	7	19	8	54	8	6	5	4	0	37	4
27	3	59	7	24	8	54	8	2	4	56	0	28	3
28	4	7	7	29	8	55	7	58	4	48	0	19	2
29	4	15	7	34	8	55	7	54	4	41	0	9	1
30	4	23	7	39	8	56	7	49	4	33	0	0	0
Sign.	11		10		9		8		7		6		Sign.
	SUBTRACT.												

TABLE *of the Second Equation of the* MOON'S Apogé.
(*According to Mr.* MACHIN.)

☽ *Apo. à* ☉	ADD.									☽ *Apo. à* ☉
Sign.	0		6	1		7	2		8	Sign.
°	°	′	″	°	′	″	°	′	″	°
0	0	0	0	9	28	24	11	40	42	30
1	0	21	5	9	42	40	11	31	21	29
2	0	42	10	9	56	27	11	20	56	28
3	1	3	13	10	9	43	11	9	25	27
4	1	24	13	10	22	28	10	56	48	26
5	1	45	10	10	34	40	10	43	8	25
6	2	6	3	10	46	19	10	28	18	24
7	2	26	51	10	57	22	10	12	25	23
8	2	47	33	11	7	48	9	55	25	22
9	3	8	8	11	17	38	9	37	21	21
10	3	28	36	11	26	49	9	18	11	20
11	3	48	56	11	35	19	8	58	5	19
12	4	9	6	11	43	8	8	36	44	18
13	4	29	6	11	50	14	8	14	28	17
14	4	48	55	11	56	35	7	51	12	16
15	5	8	33	12	2	12	7	27	0	15
16	5	27	57	12	7	1	7	1	50	14
17	5	47	8	12	11	3	6	35	45	13
18	6	6	4	12	14	15	6	18	51	12
19	6	24	45	12	16	35	5	41	8	11
20	6	43	9	12	18	4	5	12	40	10
21	7	1	16	12	18	40	4	43	28	9
22	7	19	4	12	18	21	4	13	40	8
23	7	36	33	12	17	6	3	43	16	7
24	7	53	42	12	14	54	3	12	22	6
25	8	10	29	12	11	44	2	41	0	5
26	8	26	53	12	7	35	2	9	16	4
27	8	42	54	12	2	24	1	37	13	3
28	8	58	30	11	56	12	1	4	56	2
29	9	13	41	11	49	0	0	32	30	1
30	9	28	24	11	40	42	0	0	0	0
Sign.	11		5	10		4	9		3	Sign.
	SUBTRACT.									

TABLE *of the Mean Elliptic Equation of the* Moon.										
SUBTRACT. Mean Anomaly.										
Sign.	0			1			2			Sign.
°	°	′	″	°	′	″	°	′	″	°
0	0	0	0	3	0	36	5	18	47	30
1	0	6	16	3	6	7	5	22	12	29
2	0	12	31	3	11	35	5	25	32	28
3	0	18	46	3	17	0	5	28	46	27
4	0	25	2	3	22	22	5	31	55	26
5	0	31	16	3	27	40	5	34	58	25
6	0	37	30	3	32	55	5	37	56	24
7	0	43	44	3	38	7	5	40	48	23
8	0	49	57	3	43	16	5	43	34	22
9	0	56	10	3	48	20	5	46	14	21
10	1	2	21	3	53	22	5	48	48	20
11	1	8	31	3	58	19	5	51	16	19
12	1	14	40	4	3	12	5	53	38	18
13	1	20	48	4	8	2	5	55	54	17
14	1	26	55	4	12	48	5	58	4	16
15	1	33	0	4	17	30	6	0	8	15
16	1	39	5	4	22	7	6	2	6	14
17	1	45	7	4	26	40	6	3	56	13
18	1	51	8	4	31	9	6	5	42	12
19	1	57	7	4	35	33	6	7	20	11
20	2	3	4	4	39	53	6	8	52	10
21	2	9	0	4	44	8	6	10	17	9
22	2	14	53	4	48	18	6	11	36	8
23	2	20	44	4	52	24	6	12	48	7
24	2	26	34	4	56	26	6	13	54	6
25	2	32	20	5	0	22	6	14	53	5
26	2	38	4	5	4	13	6	15	46	4
27	2	43	45	5	8	0	6	16	31	3
28	2	49	25	5	11	40	6	17	10	2
29	2	55	2	5	15	16	6	17	42	1
30	3	0	36	5	18	47	6	18	7	0
Sign.	11			10			9			Sign.
ADD. Mean Anomaly.										

TABLE *of the Mean Elliptic Equation of the* MOON.

SUBTRACT.

MEAN ANOMALY.

Sign.	3			4			5			Sign.
°	°	′	″	°	′	″	°	′	″	°
0	6	18	7	5	36	48	3	18	40	30
1	6	18	25	5	33	38	3	12	44	29
2	6	18	36	5	30	22	3	6	44	28
3	6	18	41	5	27	0	3	0	49	27
4	6	18	39	5	23	31	2	54	32	26
5	6	18	30	5	19	56	2	48	20	25
6	6	18	13	5	16	14	2	42	4	24
7	6	17	50	5	12	25	2	35	46	23
8	6	17	20	5	8	31	2	29	24	22
9	6	16	42	5	4	30	2	22	58	21
10	6	15	58	5	0	24	2	16	30	20
11	6	15	7	4	56	10	2	9	59	19
12	6	14	8	4	51	52	2	3	25	18
13	6	13	3	4	47	27	1	56	48	17
14	6	11	51	4	42	56	1	50	9	16
15	6	10	31	4	38	19	1	43	28	15
16	6	9	3	4	33	37	1	36	44	14
17	6	7	32	4	28	50	1	29	58	13
18	6	5	52	4	23	56	1	23	10	12
19	6	4	4	4	18	58	1	16	21	11
20	6	2	9	4	13	54	1	9	30	10
21	6	0	8	4	8	44	1	2	37	9
22	5	58	0	4	3	30	0	55	43	8
23	5	55	45	3	58	10	0	48	48	7
24	5	53	23	3	52	46	0	41	51	6
25	5	50	54	3	47	16	0	34	54	5
26	5	48	18	3	41	52	0	27	56	4
27	5	45	36	3	36	3	0	20	58	3
28	5	42	47	3	30	20	0	13	59	2
29	5	39	50	3	24	32	0	7	0	1
30	5	36	48	3	18	40	0	0	0	0
Sign.	8			7			6			Sign.

ADD.

MEAN ANOMALY.

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 0 Signs.

Apoge ☽ 1° Ti. equat. à ☉.	0°	1°			2°			3°			4°			5°			6°			7°			8°			9°			Apoge ☽ 1° Ti. equat. à ☉.
	A.	A.			A.			A.			A.			A.			A.			A.			A.			A.			
°		°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	°
0	0	0	1	8	0	2	17	0	3	25	0	4	33	0	5	40	0	6	48	0	7	56	0	9	4	0	10	12	0
2	0	0	1	8	0	2	16	0	3	24	0	4	32	0	5	39	0	6	47	0	7	55	0	9	2	0	10	10	2
4	0	0	1	8	0	2	15	0	3	23	0	4	30	0	5	37	0	6	45	0	7	52	0	8	59	0	10	6	4
6	0	0	1	7	0	2	14	0	3	21	0	4	27	0	5	34	0	6	40	0	7	47	0	8	53	0	10	0	6
8	0	0	1	6	0	2	11	0	3	17	0	4	23	0	5	29	0	6	35	0	7	40	0	8	46	0	9	51	8
10	0	0	1	4	0	2	9	0	3	13	0	4	18	0	5	22	0	6	27	0	7	31	0	8	35	0	9	39	10
12	0	0	1	3	0	2	6	0	3	9	0	4	12	0	5	15	0	6	18	0	7	20	0	8	23	0	9	25	12
14	0	0	1	1	0	2	2	0	3	3	0	4	4	0	5	6	0	6	7	0	7	8	0	8	8	0	9	9	14
16	0	0	0	59	0	1	59	0	2	58	0	3	57	0	4	56	0	5	55	0	6	53	0	7	25	0	8	50	16
18	0	0	0	57	0	1	53	0	2	50	0	3	47	0	4	45	0	5	42	0	6	38	0	7	33	0	8	29	18
20	0	0	0	54	0	1	48	0	2	42	0	3	37	0	4	31	0	5	26	0	6	19	0	7	12	0	8	5	20
22	0	0	0	51	0	1	42	0	2	33	0	3	26	0	4	18	0	5	11	0	6	0	0	6	50	0	7	39	22
24	0	0	0	48	0	1	36	0	2	24	0	3	13	0	4	2	0	4	51	0	5	38	0	6	25	0	7	12	24
26	0	0	0	45	0	1	30	0	2	15	0	3	0	0	3	46	0	4	31	0	5	14	0	5	58	0	6	41	26
28	0	0	0	41	0	1	22	0	2	3	0	2	45	0	3	28	0	4	10	0	4	50	0	5	29	0	6	9	28
30	0	0	0	39	0	1	19	0	1	58	0	2	35	0	3	11	0	3	48	0	4	23	0	4	59	0	5	34	30
32	0	0	0	33	0	1	6	0	1	39	0	2	14	0	2	48	0	3	23	0	3	55	0	4	26	0	4	58	32
34	0	0	0	29	0	0	57	0	1	26	0	1	56	0	2	27	0	2	57	0	3	25	0	3	53	0	4	21	34
36	0	0	0	24	0	0	49	0	1	13	0	1	39	0	2	5	0	2	31	0	2	54	0	3	18	0	3	41	36
38	0	0	0	20	0	0	41	0	1	1	0	1	22	0	1	42	0	2	3	0	2	22	0	2	41	0	3	0	38

40	0	0 0 15	0 0 31	0 0 46	0 1 2	0 1 18	0 1 34	0 1 48	0 2 3	0 2 17	40
42	0	0 0 11	0 0 21	0 0 32	0 0 43	0 0 54	0 1 5	0 1 15	0 1 24	0 1 34	42
44	0	0 0 6	0 0 11	0 0 17	0 0 23	0 0 29	0 0 35	0 0 40	0 0 44	0 0 49	44
46	0	0 0 1	0 0 1	0 0 2	0 0 3	0 0 4	0 0 5	0 0 5	0 0 4	0 0 4	46
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0	0 0 4	0 0 9	0 0 13	0 0 18	0 0 22	0 0 27	0 0 32	0 0 37	0 0 42	48
50	0	0 0 9	0 0 19	0 0 28	0 0 38	0 0 47	0 0 57	0 1 8	0 1 18	0 1 29	50
52	0	0 0 14	0 0 29	0 0 43	0 0 58	0 1 14	0 1 29	0 1 44	0 2 0	0 2 15	52
54	0	0 0 20	0 0 39	0 0 59	0 1 19	0 1 40	0 2 0	0 2 21	0 2 41	0 3 2	54
56	0	0 0 25	0 0 50	0 1 15	0 1 40	0 2 5	0 2 30	0 2 56	0 3 21	0 3 47	56
58	0	0 0 30	0 1 0	0 1 30	0 2 0	0 2 31	0 3 1	0 3 32	0 4 2	0 4 33	58
60	0	0 0 35	0 1 10	0 1 45	0 2 20	0 2 56	0 3 31	0 4 7	0 4 42	0 5 18	60
62	0	0 0 40	0 1 20	0 2 0	0 2 40	0 3 21	0 4 1	0 4 41	0 5 22	0 6 2	62
64	0	0 0 45	0 1 30	0 2 15	0 3 0	0 3 45	0 4 30	0 5 15	0 6 0	0 6 45	64
66	0	0 0 50	0 1 39	0 2 29	0 3 19	0 4 8	0 4 58	0 5 47	0 6 37	0 7 26	66
68	0	0 0 54	0 1 47	0 2 41	0 3 36	0 4 31	0 5 26	0 6 19	0 7 12	0 8 5	68
70	0	0 0 58	0 1 56	0 2 54	0 3 53	0 4 52	0 5 51	0 6 48	0 7 45	0 8 42	70
72	0	0 1 2	0 2 4	0 3 6	0 4 9	0 5 12	0 6 15	0 7 16	0 8 16	0 9 17	72
74	0	0 1 6	0 2 11	0 3 17	0 4 24	0 5 30	0 6 37	0 7 41	0 8 44	0 9 48	74
76	0	0 1 9	0 2 13	0 3 27	0 4 37	0 5 46	0 6 56	0 8 3	0 9 10	0 10 17	76
78	0	0 1 11	0 2 23	0 3 34	0 4 48	0 6 1	0 7 15	0 8 24	0 9 34	0 10 43	78
80	0	0 1 14	0 2 28	0 3 42	0 4 58	0 6 14	0 7 30	0 8 41	0 9 53	0 11 4	80
82	0	0 1 16	0 2 32	0 3 48	0 5 6	0 6 24	0 7 42	0 8 55	0 10 9	0 11 22	82
84	0	0 1 18	0 2 35	0 3 53	0 5 13	0 6 32	0 7 52	0 9 7	0 10 22	0 11 37	84
86	0	0 1 19	0 2 37	0 3 56	0 5 17	0 6 38	0 7 59	0 9 15	0 10 32	0 11 48	86
88	0	0 1 19	0 2 39	0 3 58	0 5 19	0 6 41	0 8 2	0 9 19	0 10 35	0 11 52	88
90	0	0 1 20	0 2 40	0 4 0	0 5 22	0 6 43	0 8 5	0 9 22	0 10 39	0 11 56	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

Mean Anomaly 0 Signs.

Apoge ☽ 1° Ti. equat. à ☉.	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	Apoge ☽ 1° Ti. equat. à ☉.
	A.	A.	A.	A.	A.	A.	A.	A.	A.	A.	
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	0 11 20	0 12 27	0 13 35	0 14 42	0 15 50	0 16 57	0 18 3	0 19 10	0 20 16	0 21 22	0
2	0 11 18	0 12 25	0 13 33	0 14 40	0 15 47	0 16 54	0 18 0	0 19 6	0 20 12	0 21 18	2
4	0 11 13	0 12 21	0 13 28	0 14 34	0 15 41	0 16 47	0 17 53	0 18 59	0 20 5	0 21 10	4
6	0 11 7	0 12 13	0 13 20	0 14 26	0 15 31	0 16 37	0 17 42	0 18 48	0 19 53	0 20 58	6
8	0 10 57	0 12 2	0 13 8	0 14 13	0 15 17	0 16 22	0 17 26	0 18 30	0 19 34	0 20 38	8
10	0 10 43	0 11 48	0 12 52	0 13 56	0 14 59	0 16 3	0 17 6	0 18 9	0 19 12	0 20 14	10
12	0 10 28	0 11 30	0 12 33	0 13 35	0 14 37	0 15 39	0 16 41	0 17 42	0 18 44	0 19 45	12
14	0 10 10	0 11 10	0 12 11	0 13 11	0 14 12	0 15 12	0 16 12	0 17 11	0 18 11	0 19 10	14
16	0 9 48	0 10 47	0 11 45	0 12 43	0 13 41	0 14 39	0 15 37	0 16 34	0 17 32	0 18 29	16
18	0 9 25	0 10 22	0 11 18	0 12 14	0 13 10	0 14 6	0 15 1	0 15 57	0 16 52	0 17 47	18
20	0 8 58	0 9 52	0 10 45	0 11 38	0 12 32	0 13 25	0 14 18	0 15 10	0 16 3	0 16 56	20
22	0 8 30	0 9 20	0 10 11	0 11 1	0 11 52	0 12 42	0 13 32	0 13 22	0 15 12	0 16 2	22
24	0 7 59	0 8 47	0 9 34	0 10 22	0 11 10	0 11 58	0 12 45	0 13 31	0 14 18	0 15 5	24
26	0 7 25	0 8 8	0 8 52	0 9 36	0 10 21	0 11 5	0 11 48	0 12 32	0 13 15	0 13 59	26
28	0 6 49	0 7 29	0 8 9	0 8 50	0 9 32	0 10 13	0 10 53	0 11 32	0 12 12	0 12 52	28
30	0 6 10	0 6 47	0 7 23	0 8 0	0 8 37	0 9 14	0 9 50	0 10 27	0 11 3	0 11 40	30
32	0 5 31	0 6 3	0 6 36	0 7 9	0 7 42	0 8 15	0 8 47	0 9 20	0 9 52	0 10 25	32
34	0 4 49	0 5 18	0 5 46	0 6 15	0 6 44	0 7 13	0 7 41	0 8 10	0 8 38	0 9 7	34
36	0 4 5	0 4 30	0 4 54	0 5 18	0 5 43	0 6 7	0 6 31	0 6 56	0 7 20	0 7 44	36
38	0 3 19	0 3 39	0 3 58	0 4 19	0 4 39	0 5 0	0 5 19	0 5 39	0 5 58	0 6 18	38

40	0 2 3[illegible]	0 2 47	0 3 2	0 3 18	0 3 33	0 3 49	0 4 4	0 4 20	0 4 35	0 4 50	40
42	0 1 44	0 1 54	0 2 4	0 2 15	0 2 26	0 2 37	0 2 48	0 2 58	0 3 9	0 3 19	42
44	0 0 55	0 1 0	0 1 6	0 1 12	0 1 17	0 1 23	0 1 29	0 1 35	0 1 41	0 1 47	44
46	0 0 4	0 0 5	0 0 5	0 0 6	0 0 8	0 0 9	0 0 10	0 0 11	0 0 12	0 0 13	45
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0 0 47	0 0 51	0 0 56	0 1 0	0 1 3	0 1 7	0 1 11	0 1 16	0 1 20	0 1 24	48
50	0 1 38	0 1 48	0 1 57	0 2 6	0 2 16	0 2 25	0 2 34	0 2 44	0 2 53	0 3 1	50
52	0 2 29	0 2 44	0 2 58	0 3 13	0 3 27	0 3 42	0 3 56	0 4 10	0 4 24	0 4 38	52
54	0 3 22	0 3 51	0 4 1	0 4 20	0 4 40	0 5 0	0 5 19	0 5 37	0 5 56	0 6 15	54
56	0 4 12	0 4 37	0 5 2	0 5 27	0 5 52	0 6 17	0 6 41	0 7 4	0 7 28	0 7 52	56
58	0 5 3	0 5 32	0 6 2	0 6 32	0 7 3	0 7 33	0 8 1	0 8 29	0 8 57	0 9 26	58
60	0 5 53	0 6 27	0 7 2	0 7 37	0 8 13	0 8 48	0 9 21	0 9 54	0 10 27	0 11 0	60
62	0 6 41	0 7 21	0 8 0	0 8 40	0 9 20	0 10 0	0 10 38	0 11 16	0 11 54	0 12 32	62
64	0 7 29	0 8 13	0 8 57	0 9 42	0 10 26	0 11 11	0 11 53	0 12 36	0 13 18	0 14 1	64
66	0 8 15	0 9 3	0 9 52	0 10 41	0 11 29	0 12 18	0 13 5	0 14 53	0 14 40	0 15 27	66
68	0 8 58	0 9 51	0 10 44	0 11 39	0 12 33	0 13 28	0 14 18	0 15 9	0 15 59	0 16 50	68
70	0 9 39	0 10 36	0 11 33	0 12 30	0 13 27	0 14 24	0 15 20	0 16 16	0 17 12	0 18 7	70
72	0 10 18	0 11 18	0 12 19	0 13 20	0 14 20	0 15 21	0 16 21	0 17 21	0 18 21	0 19 20	72
74	0 10 53	0 11 57	0 13 2	0 14 5	0 15 7	0 16 10	0 17 15	0 18 19	0 19 24	0 20 26	74
76	0 11 25	0 12 33	0 13 41	0 14 47	0 15 54	0 17 0	0 18 7	0 19 14	0 20 21	0 21 26	76
78	0 11 53	0 13 4	0 14 14	0 15 24	0 16 33	0 17 43	0 18 53	0 20 2	0 21 12	0 22 20	78
80	0 12 17	0 13 30	0 14 43	0 15 55	0 16 7	0 18 19	0 19 31	0 20 44	0 21 56	0 23 6	80
82	0 12 37	0 13 53	0 15 8	0 16 22	0 17 35	0 18 49	0 20 3	0 21 17	0 22 31	0 23 43	82
84	0 12 54	0 14 10	0 15 27	0 16 42	0 17 58	0 19 13	0 20 29	0 21 45	0 23 1	0 24 15	84
86	0 13 6	0 14 23	0 15 41	0 16 57	0 18 14	0 19 30	0 20 47	0 22 4	0 23 21	0 24 36	86
88	0 13 11	0 14 30	0 15 49	0 17 6	0 18 23	0 19 40	0 20 58	0 22 15	0 23 33	0 24 49	98
90	0 13 15	0 14 33	0 15 52	0 17 9	0 18 27	0 19 44	0 21 2	0 22 20	0 23 38	0 24 54	0

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 0 Signs.

Apoge ☽ 1° Ti. equat. à ☉	20° A. ° ′ ″	21° A. ° ′ ″	22° A. ° ′ ″	23° A. ° ′ ″	24° A. ° ′ ″	25° A. ° ′ ″	26° A. ° ′ ″	27° A. ° ′ ″	28° A. ° ′ ″	29° A. ° ′ ″	Apoge ☽ 1° Ti. equat. à ☉
°											°
0	0 22 28	0 23 34	0 24 40	0 25 46	0 26 52	0 27 58	0 29 3	0 30 9	0 31 13	0 32 16	0
2	0 22 24	0 23 30	0 24 35	0 25 41	0 26 46	0 27 52	0 28 57	0 30 3	0 31 7	0 32 10	2
4	0 22 16	0 23 21	0 24 26	0 25 31	0 26 36	0 27 41	0 28 47	0 29 52	0 30 55	0 31 59	4
6	0 22 3	0 23 7	0 24 12	0 25 16	0 26 21	0 27 25	0 28 30	0 29 34	0 30 37	0 31 39	6
8	0 21 41	0 22 45	0 23 49	0 24 52	0 25 56	0 27 0	0 28 3	0 29 7	0 30 9	0 31 10	8
10	0 21 15	0 22 17	0 23 20	0 24 23	0 25 26	0 26 28	0 27 30	0 28 32	0 29 33	0 30 33	10
12	0 20 46	0 21 47	0 22 48	0 23 48	0 24 49	0 25 50	0 26 51	0 27 52	0 28 51	0 29 49	12
14	0 20 10	0 21 9	0 22 8	0 23 6	0 24 5	0 25 4	0 26 4	0 27 4	0 28 1	0 28 58	14
16	0 19 26	0 20 23	0 21 20	0 22 17	0 23 14	0 24 11	0 25 9	0 26 6	0 27 2	0 27 57	16
18	0 18 43	0 19 38	0 20 32	0 21 27	0 22 21	0 23 16	0 24 11	0 25 6	0 25 58	0 26 50	18
20	0 17 48	0 18 41	0 19 33	0 20 25	0 21 17	0 22 9	0 23 2	0 23 54	0 24 45	0 25 35	20
22	0 16 52	0 17 42	0 18 31	0 19 19	0 20 8	0 20 58	0 21 48	0 22 38	0 23 26	0 24 14	22
24	0 15 52	0 16 39	0 17 25	0 18 12	0 18 58	0 19 45	0 20 31	0 21 18	0 22 3	0 22 48	24
26	0 14 43	0 15 27	0 16 10	0 16 53	0 17 36	0 18 20	0 19 3	0 19 46	0 20 28	0 21 10	26
28	0 13 33	0 14 13	0 14 52	0 15 32	0 16 11	0 16 51	0 17 30	0 18 10	0 18 49	0 19 28	28
30	0 12 17	0 12 54	0 13 30	0 14 7	0 14 43	0 15 19	0 15 54	0 16 30	0 17 5	0 17 40	30
32	0 10 58	0 11 31	0 12 3	0 12 35	0 13 7	0 13 39	0 14 12	0 14 44	0 15 16	0 15 47	32
34	0 9 35	0 10 4	0 10 29	0 10 55	0 11 20	0 11 51	0 12 23	0 12 54	0 13 22	0 13 50	34
36	0 8 9	0 8 33	0 8 57	0 9 20	0 9 44	0 10 8	0 10 33	0 10 57	0 11 21	0 11 45	36
38	0 6 38	0 6 58	0 7 14	0 7 31	0 7 47	0 8 11	0 8 34	0 8 58	0 9 17	0 9 37	38

40	0 5 5	0 5 20	0 5 35	0 5 50	0 6 5	0 6 21	0 6 37	0 6 53	0 7 8	0 7 23	40
42	0 3 30	0 3 41	0 3 51	0 4 1	0 4 11	0 4 23	0 4 35	0 4 47	0 4 57	0 5 8	42
44	0 1 52	0 1 58	0 2 3	0 2 8	0 2 13	0 2 21	0 2 28	0 2 36	0 2 42	0 2 49	44
46	0 0 13	0 0 14	0 0 15	0 0 15	0 0 16	0 0 19	0 0 23	0 0 26	0 0 27	0 0 27	46
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0 1 28	0 1 32	0 1 36	0 1 40	0 1 44	0 1 46	0 1 48	0 1 50	0 1 54	0 1 57	48
50	0 3 10	0 3 18	0 3 27	0 3 36	0 3 45	0 3 52	0 3 59	0 4 6	0 4 14	0 4 23	50
52	0 4 51	0 5 5	0 5 19	0 5 33	0 5 47	0 5 59	0 6 10	0 6 22	0 6 35	0 6 49	52
54	0 6 34	0 6 53	0 7 12	0 7 30	0 7 49	0 8 6	0 8 22	0 8 39	0 8 57	0 9 15	54
56	0 8 15	0 8 39	0 9 3	0 9 26	0 9 50	0 10 11	0 10 33	0 10 54	0 11 16	0 11 39	56
58	0 9 54	0 10 23	0 10 52	0 11 20	0 11 49	0 12 15	0 12 42	0 13 8	0 13 35	0 14 3	58
60	0 11 34	0 12 7	0 12 40	0 13 14	0 13 47	0 14 18	0 14 49	0 15 20	0 15 51	0 16 23	60
62	0 13 10	0 13 48	0 14 26	0 15 3	0 15 41	0 16 17	0 16 53	0 17 30	0 18 5	0 18 41	62
64	0 14 43	0 15 26	0 16 8	0 16 51	0 17 33	0 18 14	0 18 54	0 19 35	0 20 15	0 20 54	64
66	0 16 14	0 17 1	0 17 48	0 18 34	0 19 21	0 20 5	0 20 50	0 21 34	0 22 19	0 23 3	66
68	0 17 40	0 18 31	0 19 22	0 20 13	0 21 4	0 21 53	0 22 41	0 23 30	0 24 18	0 25 6	68
70	0 19 2	0 19 57	0 20 52	0 21 46	0 22 41	0 23 34	0 24 26	0 25 19	0 26 11	0 27 2	70
72	0 20 18	0 21 17	0 22 15	0 23 14	0 24 12	0 25 8	0 26 4	0 27 0	0 27 56	0 28 51	72
74	0 21 28	0 22 30	0 23 32	0 24 33	0 25 35	0 26 34	0 27 34	0 28 33	0 29 33	0 30 33	74
76	0 22 32	0 23 37	0 24 41	0 25 46	0 26 50	0 27 53	0 28 56	0 29 58	0 31 0	0 32 1	76
78	0 23 28	0 24 36	0 25 43	0 26 50	0 27 57	0 29 2	0 30 8	0 31 13	0 32 17	0 33 21	78
80	0 24 17	0 25 27	0 26 36	0 27 46	0 28 55	0 30 2	0 31 10	0 32 17	0 33 23	0 34 40	80
82	0 24 56	0 26 8	0 27 19	0 28 31	0 29 42	0 30 51	0 32 1	0 33 10	0 34 18	0 35 27	82
84	0 25 29	0 26 42	0 27 55	0 29 8	0 30 21	0 31 32	0 32 43	0 33 54	0 35 4	0 36 13	84
86	0 25 51	0 27 6	0 28 20	0 29 33	0 30 47	0 31 59	0 33 12	0 34 24	0 35 35	0 36 45	86
88	0 26 4	0 27 20	0 28 34	0 29 49	0 31 3	0 32 16	0 33 29	0 34 42	0 35 53	0 37 4	88
90	0 26 10	0 27 26	0 28 41	0 29 55	0 31 10	0 32 23	0 33 36	0 34 49	0 36 1	0 37 12	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 1 Sign.

Apogé ☽ 1° Ti. equat. à ☉.	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	Apogé ☽ 1° Ti. equat. à ☉.
	A.	A.	A.	A.	A.	A.	A.	A.	A.	A.	
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	0 33 20	0 34 23	0 35 27	0 36 30	0 37 33	0 38 35	0 39 38	0 40 39	0 41 41	0 42 42	0
2	0 33 14	0 34 17	0 35 20	0 36 23	0 37 25	0 38 27	0 39 28	0 40 30	0 41 32	0 42 34	2
4	0 33 2	0 34 5	0 35 7	0 36 10	0 37 12	0 38 14	0 39 16	0 40 17	0 41 18	0 42 19	4
6	0 32 42	0 33 44	0 34 46	0 35 48	0 36 50	0 37 52	0 38 54	0 39 54	0 40 54	0 41 54	6
8	0 32 12	0 33 13	0 34 14	0 35 15	0 36 16	0 37 15	0 38 17	0 39 16	0 40 16	0 41 15	8
10	0 31 34	0 32 34	0 33 33	0 34 33	0 35 33	0 36 33	0 37 33	0 38 31	0 39 29	0 40 27	10
12	0 30 48	0 31 47	0 32 46	0 33 45	0 34 43	0 35 41	0 36 39	0 37 36	0 38 33	0 39 30	12
14	0 29 55	0 30 52	0 31 48	0 32 45	0 33 42	0 34 38	0 35 35	0 36 30	0 37 26	0 38 21	14
16	0 28 53	0 29 48	0 30 43	0 31 38	0 32 31	0 33 26	0 34 22	0 35 16	0 36 9	0 37 3	16
18	0 27 42	0 28 35	0 29 28	0 30 21	0 31 14	0 32 6	0 32 59	0 33 51	0 34 42	0 35 34	18
20	0 26 26	0 27 17	0 28 8	0 28 59	0 29 49	0 30 38	0 31 28	0 32 18	0 33 7	0 33 57	20
22	0 25 2	0 25 50	0 26 37	0 27 25	0 28 13	0 29 1	0 29 49	0 30 36	0 31 23	0 32 10	22
24	0 23 33	0 24 18	0 25 3	0 25 48	0 26 33	0 27 18	0 28 3	0 28 48	0 29 33	0 30 18	24
26	0 21 52	0 22 34	0 23 16	0 23 58	0 24 40	0 25 22	0 26 4	0 26 46	0 27 27	0 28 9	26
28	0 20 7	0 20 46	0 21 24	0 22 3	0 22 42	0 23 20	0 23 59	0 24 38	0 25 17	0 25 56	28
30	0 18 15	0 18 50	0 19 26	0 20 2	0 20 37	0 21 12	0 21 47	0 22 23	0 22 59	0 23 35	30
32	0 16 19	0 16 51	0 17 22	0 17 54	0 18 26	0 18 57	0 19 29	0 20 0	0 20 31	0 21 2	32
34	0 14 18	0 14 45	0 15 13	0 15 40	0 16 09	0 16 37	0 17 6	0 17 33	0 18 0	0 18 27	34
36	0 12 9	0 12 32	0 12 56	0 13 19	0 13 44	0 14 8	0 14 33	0 14 56	0 15 19	0 15 42	36
38	0 9 56	0 10 15	0 10 35	0 10 54	0 11 14	0 11 35	0 11 55	0 12 15	0 12 34	0 12 54	38

40	0 7 38	0 7 53	0 8 08	0 8 23	0 8 39	0 8 56	0 9 12	0 9 27	0 9 43	0 9 58	40
42	0 5 18	0 5 28	0 5 38	0 5 48	0 6 1	0 6 13	0 6 26	0 6 37	0 6 48	0 6 59	42
44	0 2 55	0 3 01	0 3 6	0 3 12	0 3 20	0 3 27	0 3 35	0 3 42	0 3 49	0 3 56	44
46	0 0 28	0 0 29	0 0 31	0 0 32	0 0 35	0 0 39	0 0 42	0 0 45	0 0 48	0 0 50	46
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0 2 1	0 2 4	0 2 7	0 2 10	0 2 12	0 2 13	0 2 15	0 2 17	0 2 18	0 2 20	48
50	0 4 31	0 4 38	0 4 46	0 4 53	0 4 59	0 5 5	0 5 11	0 5 17	0 5 24	0 5 30	50
52	0 7 2	0 7 14	0 7 26	0 7 38	0 7 49	0 8 0	0 8 10	0 8 21	0 8 32	0 8 43	52
54	0 9 33	0 9 50	0 10 6	0 10 23	0 10 38	0 10 53	0 11 8	0 11 23	0 11 39	0 11 54	54
56	0 12 1	0 12 22	0 12 44	0 13 5	0 13 25	0 13 45	0 14 5	0 14 25	0 14 44	0 15 4	56
58	0 14 30	0 14 55	0 15 21	0 15 46	0 16 11	0 16 35	0 17 0	0 17 24	0 17 48	0 18 12	58
60	0 16 54	0 17 26	0 17 57	0 18 26	0 18 54	0 19 23	0 19 51	0 20 20	0 20 48	0 21 17	60
62	0 19 16	0 19 51	0 20 26	0 21 1	0 21 34	0 22 6	0 22 39	0 23 12	0 23 44	0 24 17	62
64	0 21 34	0 22 13	0 22 51	0 23 30	0 24 7	0 24 44	0 25 21	0 25 58	0 26 35	0 27 12	64
66	0 23 48	0 24 30	0 25 12	0 25 54	0 26 37	0 27 19	0 28 2	0 28 42	0 29 21	0 30 1	66
68	0 25 54	0 26 40	0 27 25	0 28 11	0 28 58	0 29 44	0 30 31	0 31 15	0 31 58	0 32 42	68
70	0 27 54	0 28 43	0 29 32	0 30 21	0 31 12	0 32 2	0 32 53	0 33 40	0 34 28	0 35 15	70
72	0 29 47	0 30 38	0 31 30	0 32 21	0 33 16	0 34 11	0 35 6	0 35 56	0 36 46	0 37 36	72
74	0 31 33	0 32 26	0 33 20	0 34 13	0 35 11	0 36 10	0 37 8	0 38 1	0 38 54	0 39 47	74
76	0 33 3	0 33 59	0 34 56	0 35 52	0 36 54	0 37 56	0 38 58	0 39 54	0 40 49	0 41 45	76
78	0 34 25	0 35 24	0 36 24	0 37 22	0 38 26	0 39 31	0 40 35	0 41 33	0 42 31	0 43 29	78
80	0 35 36	0 36 37	0 37 38	0 38 39	0 39 46	0 40 53	0 42 0	0 43 0	0 43 59	0 44 59	80
82	0 36 35	0 37 38	0 38 40	0 39 43	0 40 52	0 42 2	0 43 11	0 44 12	0 45 12	0 46 13	82
84	0 37 23	0 38 27	0 39 31	0 40 34	0 41 45	0 42 55	0 44 6	0 45 8	0 46 11	0 47 13	84
86	0 37 56	0 39 01	0 40 6	0 41 11	0 42 23	0 43 34	0 44 46	0 45 50	0 46 53	0 47 57	86
88	0 38 15	0 39 24	0 40 33	0 41 42	0 42 51	0 44 0	0 45 9	0 46 13	0 47 17	0 48 21	88
90	0 38 24	0 39 34	0 40 44	0 41 54	0 43 2	0 44 10	0 45 17	0 46 22	0 47 28	0 48 33	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY I Sign.

Apogé ☽ 1° Ti. equat. à ☉.	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	Apoge ☽ 1° Ti. equat. à ☉.
	A.	A.	A.	A.	A.	A.	A.	A.	A.	A.	
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	0 43 42	0 44 42	0 45 42	0 46 41	0 47 40	0 48 39	0 49 36	0 50 34	0 51 31	0 52 27	0
2	0 43 34	0 44 33	0 45 33	0 46 32	0 47 31	0 48 30	0 49 27	0 50 24	0 51 21	0 52 17	2
4	0 43 19	0 44 18	0 45 17	0 46 16	0 47 14	0 48 13	0 49 10	0 50 6	0 51 3	0 51 58	4
6	0 42 53	0 43 51	0 44 50	0 45 48	0 46 46	0 47 44	0 48 40	0 49 36	0 50 32	0 51 27	6
8	0 42 11	0 43 7	0 44 8	0 45 5	0 46 3	0 47 0	0 47 55	0 48 50	0 49 45	0 50 40	8
10	0 41 24	0 42 20	0 43 17	0 44 13	0 45 10	0 46 6	0 47 0	0 47 54	0 48 48	0 49 41	10
12	0 40 25	0 41 21	0 42 16	0 43 11	0 44 5	0 45 0	0 45 53	0 46 46	0 47 39	0 48 31	12
14	0 39 15	0 40 8	0 41 2	0 41 55	0 42 49	0 43 42	0 44 33	0 45 25	0 46 16	0 47 6	14
16	0 37 55	0 38 46	0 39 38	0 40 30	0 41 21	0 42 13	0 43 3	0 43 53	0 44 43	0 45 32	16
18	0 36 24	0 37 14	0 38 4	0 38 53	0 39 42	0 40 31	0 41 19	0 42 8	0 42 56	0 43 43	18
20	0 34 44	0 35 32	0 36 19	0 37 6	0 37 53	0 38 40	0 39 26	0 40 12	0 40 58	0 41 43	20
22	0 32 55	0 33 39	0 34 24	0 35 9	0 35 54	0 36 39	0 37 23	0 38 6	0 38 50	0 39 34	22
24	0 31 0	0 31 42	0 32 24	0 33 6	0 33 49	0 34 31	0 35 12	0 35 53	0 36 34	0 37 16	24
26	0 28 47	0 29 26	0 30 4	0 30 44	0 31 23	0 32 3	0 32 42	0 33 20	0 33 59	0 34 38	26
28	0 26 32	0 27 7	0 27 43	0 28 19	0 29 56	0 29 32	0 30 8	0 30 43	0 31 19	0 31 55	28
30	0 24 7	0 24 39	0 25 11	0 25 44	0 26 18	0 26 51	0 27 24	0 27 56	0 28 29	0 29 2	30
32	0 21 32	0 22 3	0 22 33	0 23 3	0 23 32	0 24 2	0 24 31	0 25 1	0 25 30	0 25 59	32
34	0 18 54	0 19 22	0 19 49	0 20 15	0 20 41	0 21 7	0 21 33	0 21 59	0 22 25	0 22 50	34
36	0 16 6	0 16 30	0 16 54	0 17 17	0 17 39	0 18 2	0 18 24	0 18 47	0 19 9	0 19 31	36
38	0 13 14	0 13 33	0 13 53	0 14 11	0 14 30	0 14 48	0 15 7	0 15 26	0 15 45	0 16 4	38

40	0 10 14	0 10 30	0 10 46	0 11 0	0 11 15	0 11 29	0 11 45	0 12 0	0 12 16	0 12 31	40
42	0 7 11	0 7 24	0 7 36	0 7 46	0 7 56	0 8 6	0 8 18	0 8 30	0 8 42	0 8 54	42
44	0 4 4	0 4 12	0 4 20	0 4 26	0 4 32	0 4 38	0 4 46	0 4 54	0 5 2	0 5 10	44
46	0 0 54	0 0 58	0 1 2	0 1 4	0 1 6	0 1 8	0 1 12	0 1 15	0 1 19	0 1 13	46
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0 2 22	0 2 23	0 2 24	0 2 25	0 2 25	0 2 26	0 2 26	0 2 27	0 2 27	0 2 27	48
50	0 5 35	0 5 41	0 5 46	0 5 51	0 5 57	0 6 2	0 6 6	0 6 11	0 6 15	0 6 19	50
52	0 8 53	0 9 2	0 9 12	0 9 21	0 9 31	0 9 40	0 9 48	0 9 56	0 10 4	0 10 11	52
54	0 12 8	0 12 22	0 12 36	0 12 50	0 13 4	0 13 18	0 13 30	0 13 41	0 13 53	0 14 4	54
56	0 15 22	0 15 41	0 15 59	0 16 17	0 16 34	0 16 52	0 17 8	0 17 24	0 17 40	0 17 55	56
58	0 18 35	0 18 58	0 19 21	0 19 42	0 20 4	0 20 25	0 20 45	0 21 4	0 21 24	0 21 43	58
60	0 21 44	0 22 10	0 22 37	0 23 3	0 23 29	0 23 55	0 24 19	0 24 43	0 25 7	0 25 30	60
62	0 24 47	0 25 18	0 25 49	0 26 19	0 26 49	0 27 19	0 28 47	0 29 14	0 28 42	0 29 8	62
64	0 27 48	0 28 24	0 28 58	0 29 31	0 30 5	0 30 38	0 31 9	0 31 41	0 32 12	0 32 42	64
66	0 30 40	0 31 18	0 31 57	0 32 34	0 33 11	0 33 48	0 34 22	0 34 57	0 35 31	0 36 5	66
68	0 33 25	0 34 7	0 34 50	0 35 31	0 36 11	0 36 52	0 37 30	0 38 8	0 38 46	0 39 22	68
70	0 36 1	0 36 46	0 37 32	0 38 16	0 39 1	0 39 45	0 40 26	0 41 7	0 41 48	0 42 27	70
72	0 38 25	0 39 15	0 40 4	0 40 51	0 41 38	0 42 25	0 43 8	0 43 51	0 44 35	0 45 18	72
74	0 40 39	0 41 31	0 42 24	0 43 14	0 44 4	0 44 54	0 45 41	0 46 27	0 47 14	0 47 59	74
76	0 42 40	0 43 35	0 44 30	0 45 22	0 46 15	0 47 7	0 47 57	0 48 46	0 49 36	0 50 22	76
78	0 44 27	0 45 24	0 46 22	0 47 16	0 48 11	0 49 5	0 49 57	0 50 49	0 51 41	0 52 30	78
80	0 45 59	0 46 59	0 47 59	0 48 55	0 49 52	0 50 48	0 51 41	0 52 34	0 53 28	0 54 19	80
82	0 47 15	0 48 16	0 49 18	0 50 17	0 51 15	0 52 14	0 53 8	0 54 3	0 54 57	0 55 49	82
84	0 48 16	0 49 18	0 50 21	0 51 22	0 52 22	0 53 23	0 54 19	0 55 14	0 56 10	0 57 4	84
86	0 49 1	0 50 5	0 51 9	0 52 10	0 53 11	0 54 12	0 55 9	0 56 5	0 57 2	0 57 56	86
88	0 49 26	0 50 32	0 51 37	0 52 37	0 53 37	0 54 38	0 55 36	0 56 33	0 57 31	0 58 25	88
90	0 49 37	0 50 41	0 51 45	0 52 46	0 53 47	0 54 48	0 55 46	0 56 44	0 57 42	0 58 37	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

Mean Anomaly 1 Sign.

Apogé ☽ 1° Ti. equat. à ☉	20° A. ° ′ ″	21° A. ° ′ ″	22° A. ° ′ ″	23° A. ° ′ ″	24° A. ° ′ ″	25° A. ° ′ ″	26° A. ° ′ ″	27° A. ° ′ ″	28° A. ° ′ ″	29° A. ° ′ ″	Apogé ☽ 1° Ti. equat. à ☉
°											°
0	0 53 23	0 54 19	0 55 13	0 56 6	0 57 0	0 57 52	0 58 44	0 59 36	1 0 25	1 1 14	0
2	0 53 12	0 54 8	0 55 1	0 55 55	0 56 48	0 57 40	0 58 32	0 59 24	1 0 13	1 1 1	2
4	0 52 54	0 53 49	0 54 42	0 55 36	0 56 29	0 57 20	0 58 12	0 59 3	0 59 52	1 0 40	4
6	0 52 23	0 53 18	0 54 10	0 55 3	0 55 55	0 56 46	0 57 37	0 58 28	0 59 16	1 0 5	6
8	0 51 34	0 52 29	0 53 21	0 54 12	0 55 4	0 55 54	0 56 45	0 57 35	0 58 23	0 59 10	8
10	0 50 35	0 51 28	0 52 20	0 53 11	0 54 3	0 54 51	0 55 39	0 56 27	0 57 14	0 58 1	10
12	0 49 24	0 50 16	0 51 6	0 51 57	0 52 47	0 53 35	0 54 22	0 55 10	0 55 56	0 56 41	12
14	0 47 56	0 48 48	0 49 37	0 50 26	0 51 15	0 52 2	0 52 48	0 53 35	0 54 19	0 55 4	14
16	0 46 21	0 47 11	0 47 58	0 48 44	0 49 31	0 50 16	0 51 2	0 51 47	0 52 31	0 53 14	16
18	0 44 30	0 45 18	0 46 3	0 46 48	0 47 33	0 48 17	0 49 2	0 49 46	0 50 27	0 51 7	18
20	0 42 29	0 43 14	0 43 57	0 44 40	0 45 23	0 46 6	0 46 48	0 47 30	0 48 10	0 48 49	20
22	0 40 17	0 41 1	0 41 41	0 42 22	0 43 2	0 43 42	0 44 23	0 45 3	0 45 40	0 46 18	22
24	0 37 57	0 38 39	0 39 17	0 39 55	0 40 33	0 41 11	0 41 49	0 42 27	0 43 3	0 44 39	24
26	0 35 16	0 35 55	0 36 31	0 37 7	0 37 43	0 38 18	0 38 54	0 39 29	0 40 3	0 40 36	26
28	0 32 31	0 33 7	0 33 40	0 34 12	0 34 45	0 35 18	0 35 52	0 36 25	0 36 57	0 37 28	28
30	0 29 35	0 30 8	0 30 38	0 31 9	0 31 39	0 32 9	0 32 40	0 33 10	0 33 39	0 34 8	30
32	0 26 27	0 26 56	0 27 25	0 27 53	0 28 22	0 28 50	0 29 17	0 29 45	0 30 12	0 30 38	32
34	0 23 16	0 23 41	0 24 7	0 24 33	0 24 59	0 25 23	0 25 48	0 26 12	0 26 36	0 26 59	34
36	0 19 53	0 20 15	0 20 37	0 21 0	0 21 22	0 21 43	0 22 5	0 22 26	0 22 47	0 23 7	36
38	0 16 23	0 16 42	0 17 1	0 17 20	0 17 39	0 17 57	0 18 15	0 18 33	0 18 50	0 19 8	38

40	0 12 47	0 13 2	0 13 17	0 13 32	0 13 47	0 14 2	0 14 18	0 14 33	0 14 47	0 15 0	40
42	0 9 5	0 9 17	0 9 29	0 9 40	0 9 52	0 10 4	0 10 15	0 10 27	0 10 37	0 10 47	42
44	0 5 18	0 5 26	0 5 34	0 5 42	0 5 50	0 5 58	0 6 7	0 6 15	0 6 22	0 6 29	44
46	0 1 18	0 1 32	0 1 37	0 1 41	0 1 46	0 1 50	0 1 54	0 1 58	0 2 1	0 2 5	46
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0 2 28	0 2 26	0 2 26	0 2 25	0 2 24	0 2 23	0 2 23	0 2 22	0 2 19	0 2 16	48
50	0 6 22	0 6 26	0 6 29	0 6 31	0 6 34	0 6 37	0 6 39	0 6 42	0 6 43	0 6 43	50
52	0 10 19	0 10 26	0 10 33	0 10 39	0 10 46	0 10 52	0 10 59	0 11 5	0 11 9	0 11 14	52
54	0 14 15	0 14 26	0 14 37	0 14 47	0 14 58	0 15 8	0 15 17	0 15 27	0 15 35	0 15 43	54
56	0 18 11	0 18 26	0 18 40	0 18 55	0 19 9	0 19 22	0 19 36	0 19 49	0 20 0	0 20 10	56
58	0 22 2	0 22 21	0 22 39	0 22 58	0 23 14	0 23 31	0 23 48	0 24 5	0 24 20	0 24 34	58
60	0 25 52	0 26 15	0 26 36	0 26 57	0 27 18	0 27 38	0 27 59	0 28 19	0 28 37	0 28 54	60
62	0 29 34	0 30 0	0 30 25	0 30 49	0 31 14	0 31 37	0 32 1	0 32 24	0 32 45	0 33 7	62
64	0 33 11	0 33 41	0 34 9	0 34 37	0 35 5	0 35 32	0 35 58	0 36 25	0 36 49	0 37 14	64
66	0 36 38	0 37 12	0 37 44	0 38 16	0 38 48	0 39 17	0 39 47	0 40 16	0 40 43	0 41 9	66
68	0 39 58	0 40 34	0 41 9	0 41 44	0 42 19	0 42 52	0 43 24	0 43 57	0 44 26	0 44 56	68
70	0 43 7	0 43 46	0 44 23	0 45 0	0 45 37	0 46 13	0 46 50	0 47 26	0 47 58	0 48 30	70
72	0 46 2	0 46 45	0 47 25	0 48 6	0 48 46	0 49 24	0 50 3	0 50 41	0 51 15	0 51 49	72
74	0 48 43	0 49 28	0 50 11	0 50 54	0 51 38	0 52 18	0 52 58	0 53 38	0 54 15	0 54 51	74
76	0 51 8	0 51 54	0 52 39	0 53 25	0 54 10	0 54 53	0 55 37	0 56 20	0 56 58	0 57 37	76
78	0 53 19	0 54 8	0 54 55	0 55 43	0 56 30	0 57 15	0 57 59	0 58 44	0 59 24	1 0 3	78
80	0 55 11	0 56 2	0 56 51	0 57 40	0 58 29	0 59 15	1 0 1	1 0 47	1 1 28	1 2 10	80
82	0 56 42	0 57 34	0 58 24	0 59 15	1 0 5	1 0 53	1 1 40	1 2 28	1 3 12	1 3 55	82
84	0 57 5[illegible]	0 58 50	0 59 42	1 0 34	1 1 26	1 2 15	1 3 4	1 3 53	1 4 36	1 5 20	84
86	0 58 50	0 59 44	1 0 37	1 1 29	1 2 22	1 3 11	1 4 1	1 4 50	1 5 34	1 6 19	86
88	0 59 20	1 0 14	1 1 7	1 2 1	1 2 54	1 3 44	1 4 34	1 5 24	1 6 9	1 6 53	88
90	0 59 3[illegible]	1 0 27	1 1 23	1 2 20	1 3 6	1 3 56	1 4 46	1 5 36	1 6 21	1 7 7	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 1 Sign.

Apogé ☽ 1° Ti. equat. à ☉.	20° A. ° ′ ″	21° A. ° ′ ″	22° A. ° ′ ″	23° A. ° ′ ″	24° A. ° ′ ″	25° A. ° ′ ″	26° A. ° ′ ″	27° A. ° ′ ″	28° A. ° ′ ″	29° A. ° ′ ″	Apogé ☽ 1° Ti. equat. à ☉.
°											°
0	0 53 23	0 54 19	0 55 13	0 56 6	0 57 0	0 57 52	0 58 44	0 59 36	1 0 25	1 1 14	0
2	0 53 12	0 54 8	0 55 1	0 55 55	0 56 48	0 57 40	0 58 32	0 59 24	1 0 13	1 1 1	2
4	0 52 54	0 53 49	0 54 42	0 55 36	0 56 29	0 57 20	0 58 12	0 59 3	0 59 52	1 0 40	4
6	0 52 23	0 53 18	0 54 10	0 55 3	0 55 55	0 56 46	0 57 37	0 58 28	0 59 16	1 0 5	6
8	0 51 34	0 52 29	0 53 21	0 54 12	0 55 4	0 55 54	0 56 45	0 57 35	0 58 23	0 59 10	8
10	0 50 35	0 51 28	0 52 20	0 53 11	0 54 3	0 54 51	0 55 39	0 56 27	0 57 14	0 58 1	10
12	0 49 24	0 50 16	0 51 6	0 51 57	0 52 47	0 53 35	0 54 22	0 55 10	0 55 56	0 56 41	12
14	0 47 56	0 48 48	0 49 37	0 50 26	0 51 15	0 52 2	0 52 48	0 53 35	0 54 19	0 55 4	14
16	0 46 21	0 47 11	0 47 58	0 48 44	0 49 31	0 50 16	0 51 2	0 51 47	0 52 31	0 53 14	16
18	0 44 30	0 45 18	0 46 3	0 46 48	0 47 33	0 48 17	0 49 2	0 49 46	0 50 27	0 51 7	18
20	0 42 29	0 43 14	0 43 57	0 44 40	0 45 23	0 46 6	0 46 48	0 47 30	0 48 10	0 48 49	20
22	0 40 17	0 41 1	0 41 41	0 42 22	0 43 2	0 43 42	0 44 23	0 45 3	0 45 40	0 46 18	22
24	0 37 57	0 38 39	0 39 17	0 39 55	0 40 33	0 41 11	0 41 49	0 42 27	0 43 3	0 44 39	24
26	0 35 16	0 35 55	0 36 31	0 37 7	0 37 43	0 38 18	0 38 54	0 39 29	0 40 3	0 40 36	26
28	0 32 31	0 33 7	0 33 40	0 34 12	0 34 45	0 35 18	0 35 52	0 36 25	0 36 57	0 37 28	28
30	0 29 35	0 30 8	0 30 38	0 31 9	0 31 39	0 32 9	0 32 40	0 33 10	0 33 39	0 34 8	30
32	0 26 27	0 26 56	0 27 25	0 27 53	0 28 22	0 28 50	0 29 17	0 29 45	0 30 12	0 30 38	32
34	0 23 16	0 23 41	0 24 7	0 24 33	0 24 59	0 25 23	0 25 48	0 26 12	0 26 36	0 26 59	34
36	0 19 53	0 20 15	0 20 37	0 21 0	0 21 22	0 21 43	0 22 5	0 22 26	0 22 47	0 23 7	36
38	0 16 23	0 16 42	0 17 1	0 17 20	0 17 39	0 17 57	0 18 15	0 18 33	0 18 50	0 19 8	38

40	0 12 47	0 13 2	0 13 17	0 13 32	0 13 47	0 14 2	0 14 18	0 14 33	0 14 47	0 15 0	40
42	0 9 5	0 9 17	0 9 29	0 9 40	0 9 52	0 10 4	0 10 15	0 10 27	0 10 37	0 10 47	42
44	0 5 18	0 5 26	0 5 34	0 5 42	0 5 50	0 5 58	0 6 7	0 6 15	0 6 22	0 6 29	44
46	0 1 18	0 1 32	0 1 37	0 1 41	0 1 46	0 1 50	0 1 54	0 1 58	0 2 1	0 2 5	46
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0 2 28	0 2 26	0 2 26	0 2 25	0 2 24	0 2 23	0 2 23	0 2 22	0 2 19	0 2 16	48
50	0 6 22	0 6 26	0 6 29	0 6 31	0 6 34	0 6 37	0 6 39	0 6 42	0 6 43	0 6 43	50
52	0 10 19	0 10 26	0 10 33	0 10 39	0 10 46	0 10 52	0 10 59	0 11 5	0 11 9	0 11 14	52
54	0 14 15	0 14 26	0 14 37	0 14 47	0 14 58	0 15 8	0 15 17	0 15 27	0 15 35	0 15 43	54
56	0 18 11	0 18 26	0 18 40	0 18 55	0 19 9	0 19 22	0 19 36	0 19 49	0 20 0	0 20 10	56
58	0 22 2	0 22 21	0 22 39	0 22 58	0 23 14	0 23 31	0 23 48	0 24 5	0 24 20	0 24 34	58
60	0 25 52	0 26 15	0 26 36	0 26 57	0 27 18	0 27 38	0 27 59	0 28 19	0 28 37	0 28 54	60
62	0 29 34	0 30 0	0 30 25	0 30 49	0 31 14	0 31 37	0 32 1	0 32 24	0 32 45	0 33 7	62
64	0 33 11	0 33 41	0 34 9	0 34 37	0 35 5	0 35 32	0 35 58	0 36 25	0 36 49	0 37 14	64
66	0 36 38	0 37 12	0 37 44	0 38 16	0 38 48	0 39 17	0 39 47	0 40 16	0 40 43	0 41 9	66
68	0 39 58	0 40 34	0 41 9	0 41 44	0 42 19	0 42 52	0 43 24	0 43 57	0 44 26	0 44 56	68
70	0 43 7	0 43 46	0 44 23	0 45 0	0 45 37	0 46 13	0 46 50	0 47 26	0 47 58	0 48 30	70
72	0 46 2	0 46 45	0 47 25	0 48 6	0 48 46	0 49 24	0 50 3	0 50 41	0 51 15	0 51 49	72
74	0 48 43	0 49 28	0 50 11	0 50 54	0 51 38	0 52 18	0 52 58	0 53 38	0 54 15	0 54 51	74
76	0 51 8	0 51 54	0 52 39	0 53 25	0 54 10	0 54 53	0 55 37	0 56 20	0 56 58	0 57 37	76
78	0 53 19	0 54 8	0 54 55	0 55 43	0 56 30	0 57 15	0 57 59	0 58 44	0 59 24	1 0 3	78
80	0 55 11	0 56 2	0 56 51	0 57 40	0 58 29	0 59 15	1 0 1	1 0 47	1 1 28	1 2 10	80
82	0 56 42	0 57 34	0 58 24	0 59 15	1 0 5	1 0 53	1 1 40	1 2 28	1 3 12	1 3 55	82
84	0 57 57	0 58 50	0 59 42	1 0 34	1 1 26	1 2 15	1 3 4	1 3 53	1 4 36	1 5 20	84
86	0 58 50	0 59 44	1 0 37	1 1 29	1 2 22	1 3 11	1 4 1	1 4 50	1 5 34	1 6 19	86
88	0 59 20	1 0 14	1 1 7	1 2 1	1 2 54	1 3 44	1 4 34	1 5 24	1 6 9	1 6 53	88
90	0 59 32	1 0 27	1 1 23	1 2 20	1 3 6	1 3 56	1 4 46	1 5 36	1 6 21	1 7 7	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

Mean Anomaly 2 Signs.

Apogé ☽ 1° Ti. equat. à ☉.	0° A.	1° A.	2° A.	3° A.	4° A.	5° A.	6° A.	7° A.	8° A.	9° A.	Apogé ☽ 1° Ti. equat. à ☉.
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	1 2 3	1 2 52	1 3 42	1 4 31	1 5 17	1 6 2	1 6 48	1 7 31	1 8 13	1 8 56	0
2	1 1 50	1 2 39	1 3 28	1 4 17	1 5 3	1 5 49	1 6 35	1 7 18	1 8 0	1 8 43	2
4	1 1 29	1 2 18	1 3 7	1 3 56	1 4 41	1 5 25	1 6 10	1 6 53	1 7 36	1 8 19	4
6	1 0 53	1 1 41	1 2 30	1 3 18	1 4 2	1 4 47	1 5 31	1 6 14	1 6 56	1 7 39	6
8	0 59 58	1 0 45	1 1 33	1 2 20	1 3 4	1 3 49	1 4 33	1 5 15	1 5 56	1 6 38	8
10	0 58 48	0 59 35	1 0 21	1 1 8	1 1 52	1 2 37	1 3 21	1 4 1	1 4 42	1 5 22	10
12	0 57 27	0 58 13	0 58 58	0 59 44	1 0 27	1 1 9	1 1 52	1 2 32	1 3 12	1 3 52	12
14	0 55 48	0 56 32	0 57 17	0 58 1	0 58 43	0 59 25	1 0 7	1 0 46	1 1 24	1 2 3	14
16	0 53 58	0 54 40	0 55 22	0 56 4	0 56 44	0 57 23	0 58 3	0 58 41	0 59 20	0 59 58	16
18	0 51 48	0 52 30	0 53 11	0 53 53	0 54 32	0 55 10	0 55 48	0 56 25	0 57 1	0 57 38	18
20	0 49 29	0 50 8	0 50 48	0 51 27	0 52 4	0 52 42	0 53 19	0 53 54	0 54 29	0 55 4	20
22	0 46 55	0 47 33	0 48 11	0 48 49	0 49 24	0 50 0	0 50 35	0 51 9	0 51 42	0 52 16	22
24	0 44 15	0 44 50	0 45 26	0 46 1	0 46 35	0 47 9	0 47 43	0 48 15	0 48 46	0 49 18	24
26	0 41 10	0 41 43	0 42 17	0 42 50	0 43 21	0 43 53	0 44 24	0 44 54	0 45 24	0 45 54	26
28	0 37 59	0 38 30	0 39 1	0 39 32	0 40 1	0 40 31	0 41 0	0 41 28	0 41 56	0 42 24	28
30	0 34 37	0 35 5	0 35 34	0 36 2	0 36 29	0 36 56	0 37 23	0 37 49	0 38 15	0 38 41	30
32	0 31 5	0 31 31	0 31 56	0 32 22	0 32 46	0 33 11	0 33 35	0 33 59	0 34 22	0 34 46	32
34	0 27 23	0 27 47	0 28 10	0 28 33	0 28 55	0 29 16	0 29 38	0 30 0	0 30 22	0 30 44	34
36	0 23 28	0 23 49	0 24 9	0 24 30	0 24 49	0 25 9	0 25 28	0 25 47	0 26 7	0 26 26	36
38	0 19 25	0 19 43	0 20 2	0 20 20	0 20 37	0 20 53	0 21 10	0 21 27	0 21 43	0 22 0	38

40	0 15 14	0 15 30	0 15 46	0 16 2	0 16 15	0 16 30	0 16 44	0 16 58	0 17 12	0 17 26	40
42	0 10 57	0 11 11	0 11 24	0 11 38	0 11 49	0 12 0	0 12 11	0 12 22	0 12 33	0 12 44	42
44	0 6 36	0 6 47	0 6 57	0 7 8	0 7 16	0 7 24	0 7 32	0 7 41	0 7 49	0 7 58	44
46	0 2 8	0 2 16	0 2 25	0 2 33	0 2 38	0 2 43	0 2 48	0 2 54	0 3 0	0 3 6	46
	S.	S.	S.	S.	S.	S.	S.	S.	S,	S.	
48	0 2 13	0 2 14	0 2 15	0 2 6	0 2 4	0 2 2	0 2 0	0 1 57	0 1 53	0 1 50	48
50	0 6 44	0 6 46	0 6 48	0 6 50	0 6 50	0 6 49	0 6 49	0 6 49	0 6 48	0 6 48	50
52	0 11 18	0 11 22	0 11 26	0 11 30	0 11 33	0 11 37	0 11 40	0 11 42	0 11 45	0 11 47	52
54	0 15 51	0 15 58	0 16 5	0 16 12	0 16 19	0 16 25	0 16 32	0 16 37	0 16 42	0 16 47	54
56	0 20 21	0 20 31	0 20 42	0 20 52	0 21 1	0 21 11	0 21 20	0 21 28	0 21 35	0 21 43	56
58	0 24 49	0 25 3	0 25 16	0 25 28	0 25 40	0 25 52	0 26 4	0 26 15	0 26 25	0 26 36	58
60	0 29 12	0 29 28	0 29 44	0 30 0	0 30 15	0 30 30	0 30 45	0 30 58	0 31 11	0 31 24	60
62	0 33 28	0 33 47	0 34 7	0 34 26	0 34 43	0 35 1	0 35 18	0 35 34	0 35 50	0 36 6	62
64	0 37 38	0 38 0	0 38 22	0 38 44	0 39 4	0 39 24	0 39 44	0 40 3	0 40 22	0 40 41	64
66	0 41 36	0 42 1	0 42 27	0 42 52	0 43 15	0 43 37	0 44 0	0 44 21	0 44 41	0 45 2	66
68	0 45 25	0 45 53	0 46 20	0 46 48	0 47 13	0 47 38	0 48 3	0 48 26	0 48 49	0 49 12	68
70	0 49 2	0 49 32	0 50 2	0 50 32	0 50 59	0 51 27	0 51 54	0 52 19	0 52 44	0 53 9	70
72	0 52 23	0 52 55	0 53 28	0 54 0	0 54 30	0 54 59	0 55 29	0 55 55	0 56 22	0 56 48	72
74	0 55 28	0 56 3	0 56 37	0 57 12	0 57 42	0 58 15	0 58 46	0 59 15	0 59 43	1 0 12	74
76	0 58 15	0 58 52	0 59 28	1 0 5	1 0 38	1 1 11	1 1 44	1 2 14	1 2 45	1 3 15	76
78	1 0 43	1 1 22	1 2 0	1 2 39	1 3 14	1 3 48	1 4 23	1 4 54	1 5 26	1 5 57	78
80	1 2 51	1 3 31	1 4 12	1 4 52	1 5 28	1 6 4	1 6 40	1 7 12	1 7 45	1 8 17	80
82	1 4 39	1 5 20	1 6 0	1 6 41	1 7 18	1 7 56	1 8 33	1 9 7	1 9 40	1 10 14	82
84	1 6 3	1 6 45	1 7 27	1 8 9	1 8 47	1 9 26	1 10 4	1 10 38	1 11 12	1 11 46	84
86	1 7 3	1 7 46	1 8 28	1 9 11	1 9 50	1 10 29	1 11 8	1 11 43	1 12 18	1 12 53	86
88	1 7 38	1 8 21	1 9 3	1 9 46	1 10 25	1 11 5	1 11 44	1 12 19	1 12 55	1 13 30	88
90	1 7 52	1 8 35	1 9 18	1 10 1	1 10 41	1 11 20	1 12 0	1 12 35	1 13 11	1 13 46	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

Mean Anomaly, 2 Signs.

Apoge ☽ 1° Ti. equat. à ☉	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	Apoge ☽ 1° Ti. equat. à ☉
	A.	A.	A.	A.	A.	A.	A.	A.	A.	A.	
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	1 9 36	1 10 16	1 10 56	1 11 33	1 12 11	1 12 48	1 13 23	1 13 57	1 14 32	1 15 3	0
2	1 9 23	1 10 2	1 10 42	1 11 19	1 11 57	1 12 34	1 13 9	1 13 43	1 14 18	1 14 51	2
4	1 8 59	1 9 39	1 10 19	1 10 56	1 11 32	1 12 9	1 12 44	1 13 18	1 13 53	1 14 23	4
6	1 8 18	1 8 58	1 9 37	1 10 14	1 10 50	1 11 27	1 12 2	1 12 36	1 13 11	1 13 41	6
8	1 7 17	1 7 55	1 8 34	1 9 10	1 9 47	1 10 23	1 10 57	1 11 30	1 12 4	1 12 34	8
10	1 6 0	1 6 38	1 7 16	1 7 52	1 8 27	1 9 3	1 9 36	1 10 10	1 10 43	1 11 13	10
12	1 3 29	1 4 7	1 5 44	1 6 19	1 6 53	1 7 28	1 8 1	1 8 33	1 9 6	1 9 35	12
14	1 2 40	1 3 16	1 3 53	1 4 27	1 5 0	1 5 34	1 6 6	1 6 37	1 7 9	1 7 37	14
16	1 0 33	1 1 8	1 1 43	1 2 16	1 2 48	1 3 21	1 3 52	1 4 24	1 4 55	1 5 22	16
18	0 58 11	0 58 45	0 59 18	0 59 51	1 0 24	1 0 57	1 1 27	1 1 56	1 2 26	1 2 53	18
20	0 55 38	0 56 13	0 56 47	0 57 16	0 57 46	0 58 15	0 58 44	0 59 12	0 59 41	1 0 6	20
22	0 52 47	0 53 19	0 53 50	0 54 20	0 54 49	0 55 19	0 55 46	0 56 13	0 56 40	0 57 5	22
24	0 49 48	0 50 17	0 50 47	0 51 16	0 51 44	0 52 13	0 52 39	0 53 4	0 53 30	0 53 53	24
26	0 46 22	0 46 50	0 47 18	0 47 45	0 48 11	0 48 38	0 49 02	0 49 27	0 49 51	0 50 13	26
28	0 42 50	0 43 16	0 43 42	0 44 7	0 44 33	0 44 58	0 45 20	0 45 43	0 46 5	0 46 26	28
30	0 39 5	0 39 28	0 39 52	0 40 16	0 40 39	0 41 3	0 41 24	0 41 45	0 42 6	0 42 26	30
32	0 35 9	0 35 31	0 35 54	0 36 15	0 36 35	0 36 56	0 37 16	0 37 36	0 37 56	0 38 15	32
34	0 31 5	0 31 26	0 31 45	0 32 4	0 32 22	0 32 41	0 32 59	0 33 18	0 33 36	0 33 53	34
36	0 26 44	0 27 3	0 27 21	0 27 38	0 27 54	0 28 11	0 28 27	0 28 44	0 29 0	0 29 15	36
38	0 22 16	0 22 32	0 22 48	0 23 3	0 23 18	0 23 33	0 23 47	0 24 2	0 24 16	0 24 29	38

40	0 17 40	0 17 53	0 18 7	0 18 20	0 18 32	0 18 45	0 18 58	0 19 1	0 19 24	0 19 35	40
42	0 12 56	0 13 7	0 13 19	0 13 30	0 13 40	0 13 51	0 14 2	0 14 13	0 14 24	0 14 33	42
44	0 8 07	0 8 16	0 8 25	0 8 33	0 8 42	0 8 50	0 8 59	0 9 7	0 9 16	0 9 24	44
46	0 3 13	0 3 19	0 3 26	0 3 22	0 3 38	0 3 44	0 3 51	0 3 58	0 4 5	0 4 11	46
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0 1 46	0 1 42	0 1 38	0 1 34	0 1 31	0 1 27	0 1 23	0 1 18	0 1 14	0 1 9	48
50	0 6 47	0 6 45	0 6 44	0 6 42	0 6 41	0 6 39	0 6 36	0 6 34	0 6 31	0 6 29	50
52	0 11 48	0 11 49	0 11 48	0 11 50	0 11 52	0 11 54	0 11 54	0 11 53	0 11 53	0 11 52	52
54	0 11 50	0 11 54	0 16 57	0 17 1	0 17 4	0 17 8	0 17 9	0 17 10	0 17 11	0 17 12	54
56	0 21 49	0 21 54	0 22 0	0 22 6	0 22 13	0 22 19	0 22 22	0 22 25	0 22 28	0 22 30	56
58	0 26 44	0 26 52	0 27 0	0 27 9	0 27 17	0 27 26	0 27 31	0 27 35	0 27 40	0 27 44	58
60	0 31 34	0 31 45	0 31 55	0 32 6	0 32 18	0 32 29	0 32 36	0 32 42	0 32 49	0 32 54	60
62	0 36 19	0 36 31	0 36 44	0 36 57	0 37 11	0 37 24	0 37 32	0 37 40	0 37 48	0 37 55	62
64	0 40 55	0 41 9	0 41 23	0 41 39	0 41 54	0 42 10	0 42 19	0 42 29	0 42 38	0 42 47	64
66	0 45 19	0 45 35	0 45 52	0 46 9	0 46 27	0 46 44	0 46 56	0 47 7	0 47 19	0 47 29	66
68	0 49 31	0 49 50	0 50 9	0 50 28	0 50 47	0 51 6	0 51 20	0 51 33	0 51 47	0 51 58	68
70	0 53 30	0 53 50	0 54 11	0 54 32	0 54 53	0 55 14	0 55 29	0 55 43	0 55 58	0 56 11	70
72	0 57 11	0 57 34	0 57 57	0 58 20	0 58 42	0 59 5	0 59 21	0 59 37	0 59 53	1 0 7	72
74	1 0 36	1 1 1	1 1 25	1 1 49	1 2 13	1 2 37	1 2 55	1 3 12	1 3 30	1 3 45	74
76	1 3 41	1 4 7	1 4 33	1 4 58	1 5 23	1 5 48	1 6 7	1 6 26	1 6 45	1 7 1	76
78	1 6 24	1 6 52	1 7 19	1 7 45	1 7 12	1 8 38	1 8 58	1 9 18	1 9 38	1 9 54	78
80	1 8 45	1 9 14	1 9 42	1 10 9	1 10 36	1 11 3	1 11 25	1 11 46	1 12 8	1 12 24	80
82	1 10 43	1 11 12	1 11 41	1 12 10	1 12 38	1 13 7	1 13 28	1 13 50	1 14 11	1 14 29	82
84	1 12 16	1 12 47	1 13 17	1 13 46	1 14 15	1 14 44	1 15 5	1 15 25	1 15 46	1 16 6	84
86	1 13 23	1 13 54	1 14 24	1 14 53	1 15 23	1 15 52	1 16 15	1 16 38	1 17 1	1 17 20	86
88	1 14 1	1 14 32	1 15 3	1 15 33	1 16 2	1 16 32	1 16 55	1 17 18	1 17 41	1 18 0	88
90	1 14 17	1 14 49	1 15 20	1 15 50	1 16 19	1 16 49	1 17 12	1 17 35	1 17 58	1 18 17	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

Mean Anomaly 2 Signs.

Apogé ☽ 1° Ti. equat à ☉.	20° A. ° ′ ″	21° A. ° ′ ″	22° A. ° ′ ″	23° A. ° ′ ″	24° A. ° ′ ″	25° A. ° ′ ″	26° A. ° ′ ″	27° A. ° ′ ″	28° A. ° ′ ″	29° A. ° ′ ″	Apogé ☽ 1° Ti. equat à ☉.
°											°
0	1 15 34	1 16 5	1 16 32	1 17 0	1 17 27	1 17 51	1 18 16	1 18 40	1 19 0	1 19 20	0
2	1 15 20	1 15 50	1 16 17	1 16 45	1 17 12	1 17 37	1 18 1	1 18 25	1 18 45	1 19 4	2
4	1 14 54	1 15 24	1 15 51	1 16 18	1 16 45	1 17 9	1 17 34	1 17 58	1 18 18	1 18 37	4
6	1 14 11	1 14 41	1 15 8	1 15 35	1 16 2	1 16 26	1 16 50	1 17 14	1 17 33	1 17 53	6
8	1 13 5	1 13 35	1 14 1	1 14 27	1 14 53	1 15 17	1 15 41	1 16 5	1 16 24	1 16 44	8
10	1 11 42	1 12 12	1 12 38	1 13 5	1 13 31	1 13 54	1 14 17	1 14 40	1 14 59	1 15 18	10
12	1 10 3	1 10 32	1 10 57	1 11 23	1 11 48	1 12 12	1 12 36	1 13 0	1 13 18	1 13 37	12
14	1 8 6	1 8 34	1 8 59	1 9 24	1 9 49	1 10 11	1 10 34	1 10 57	1 11 15	1 11 33	14
16	1 5 50	1 6 17	1 6 42	1 7 6	1 7 31	1 7 52	1 8 13	1 8 34	1 8 53	1 9 11	16
18	1 3 19	1 3 46	1 4 9	1 4 33	1 4 56	1 5 17	1 5 39	1 6 0	1 6 18	1 6 35	18
20	1 0 32	1 0 57	1 1 20	1 1 42	1 2 5	1 2 26	1 2 46	1 3 7	1 3 24	1 3 40	20
22	0 57 29	0 57 54	0 58 15	0 58 37	0 58 58	0 59 18	0 59 38	0 59 58	1 0 14	1 0 31	22
24	0 54 17	0 54 40	0 55 0	0 55 21	0 55 41	0 56 0	0 56 19	0 56 38	0 56 54	0 57 9	24
26	0 50 35	0 50 57	0 51 16	0 51 35	0 51 54	0 52 13	0 52 31	0 52 50	0 53 5	0 53 19	26
28	0 46 47	0 47 8	0 47 26	0 47 44	0 48 2	0 48 19	0 48 37	0 48 54	0 49 8	0 49 22	28
30	0 42 45	0 43 5	0 43 22	0 43 38	0 43 55	0 44 11	0 44 28	0 44 44	0 44 57	0 45 11	30
32	0 38 33	0 38 51	0 39 7	0 39 22	0 39 38	0 39 53	0 40 7	0 40 22	0 40 35	0 40 47	32
34	0 34 10	0 34 27	0 34 41	0 34 56	0 35 10	0 35 24	0 35 39	0 35 53	0 36 4	0 36 16	34
36	0 29 31	0 29 46	0 29 59	0 30 12	0 30 25	0 30 38	0 30 51	0 31 4	0 31 15	0 31 25	36
38	0 24 43	0 24 56	0 25 8	0 25 19	0 25 31	0 25 42	0 25 54	0 26 6	0 26 16	0 26 25	38

40	0 19 47	0 19 58	0 20 8	0 20 19	0 20 29	0 20 39	0 20 50	0 21 0	0 21 9	0 21 17	40
42	0 14 43	0 14 52	0 15 1	0 15 10	0 15 19	0 15 28	0 15 38	0 15 47	0 15 56	0 16 4	42
44	0 9 32	0 9 40	0 9 48	0 9 55	0 10 3	0 10 11	0 10 18	0 10 26	0 10 34	0 10 43	44
46	0 4 17	0 4 23	0 4 29	0 4 35	0 4 41	0 4 48	0 4 54	0 5 1	0 5 9	0 5 16	46
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0 1 5	0 1 0	0 0 55	0 0 51	0 0 46	0 0 41	0 0 35	0 0 30	0 0 16	0 0 2	48
50	0 6 26	0 6 24	0 6 21	0 6 17	0 6 14	0 6 10	0 6 5	0 6 1	0 5 56	0 5 51	50
52	0 11 50	0 11 49	0 11 47	0 11 46	0 11 44	0 11 41	0 11 39	0 11 36	0 11 32	0 11 28	52
54	0 17 12	0 17 13	0 17 13	0 17 13	0 17 13	0 17 11	0 17 8	0 17 6	0 17 4	0 17 1	54
56	0 22 33	0 22 35	0 22 36	0 22 38	0 22 39	0 22 38	0 22 37	0 22 36	0 22 34	0 22 33	56
58	0 27 48	0 27 52	0 27 55	0 27 57	0 28 0	0 28 0	0 28 0	0 28 1	0 28 1	0 28 0	58
60	0 33 0	0 33 5	0 33 9	0 33 14	0 33 18	0 33 19	0 33 20	0 33 21	0 33 22	0 33 23	60
62	0 38 2	0 38 9	0 38 15	0 38 20	0 38 26	0 38 29	0 38 32	0 38 35	0 38 36	0 38 37	62
64	0 42 55	0 43 4	0 43 12	0 43 19	0 43 27	0 43 31	0 43 34	0 43 38	0 43 39	0 43 41	64
66	0 47 39	0 47 49	0 47 57	0 48 6	0 48 14	0 48 19	0 48 23	0 48 28	0 48 31	0 48 33	66
68	0 52 9	0 52 20	0 52 30	0 52 39	0 52 49	0 52 54	0 52 59	0 53 4	0 53 8	0 53 11	68
70	0 56 23	0 56 36	0 56 46	0 56 57	0 57 7	0 57 14	0 57 21	0 57 28	0 57 32	0 57 36	70
72	1 0 21	1 0 35	1 0 46	1 0 58	1 1 9	1 1 17	1 1 24	1 1 32	1 1 36	1 1 41	72
74	1 3 59	1 4 14	1 4 26	1 4 39	1 4 51	1 4 59	1 5 8	1 5 16	1 5 21	1 1 27	74
76	1 7 16	1 7 32	1 7 45	1 7 59	1 8 12	1 8 21	1 8 30	1 8 39	1 8 45	1 8 51	76
78	1 10 11	1 10 27	1 10 41	1 10 56	1 11 10	1 11 20	1 11 29	1 11 39	1 11 45	1 11 51	78
80	1 12 41	1 12 57	1 13 12	1 13 28	1 13 43	1 13 53	1 14 4	1 14 14	1 14 20	1 14 27	80
82	1 14 47	1 15 5	1 15 20	1 15 35	1 15 50	1 16 1	1 16 11	1 16 22	1 16 29	1 16 36	82
84	1 16 25	1 16 45	1 17 0	1 17 16	1 17 32	1 17 43	1 17 55	1 18 6	1 18 13	1 18 20	84
86	1 17 38	1 17 57	1 18 13	1 18 29	1 18 45	1 18 56	1 19 8	1 19 19	1 19 26	1 19 33	86
88	1 18 20	1 18 39	1 18 55	1 19 11	1 19 27	1 19 38	1 19 50	1 20 1	1 20 8	1 20 15	88
90	1 18 35	1 18 54	1 19 10	1 19 27	1 19 43	1 19 54	1 20 6	1 20 17	1 20 24	1 20 31	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

Mean Anomaly 3 Signs.

Apoge ☽ 1° Ti. equat. à ☉.	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	Apoge ☽ 1° Ti. equat. à ☉.
	A.	A.	A.	A.	A.	A.	A.	A.	A.	A.	
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	1 19 40	1 19 56	1 20 12	1 20 28	1 20 40	1 20 51	1 21 3	1 21 11	1 21 18	1 21 26	0
2	1 19 24	1 19 40	1 19 57	1 20 13	1 20 25	1 20 36	1 20 48	1 20 56	1 21 4	1 21 12	2
4	1 18 57	1 19 13	1 19 30	1 19 46	1 19 57	1 19 9	1 20 20	1 20 28	1 20 36	1 20 44	4
6	1 18 12	1 18 28	1 18 44	1 19 0	1 19 12	1 19 23	1 19 35	1 19 43	1 19 50	1 19 58	6
8	1 17 3	1 17 19	1 17 34	1 17 50	1 18 1	1 18 12	1 18 24	1 18 32	1 18 40	1 18 48	8
10	1 15 37	1 15 53	1 16 8	1 16 24	1 16 35	1 16 45	1 16 56	1 17 3	1 17 11	1 17 19	10
12	1 13 55	1 14 11	1 14 26	1 14 42	1 14 52	1 15 2	1 15 12	1 15 20	1 15 27	1 15 35	12
14	1 11 51	1 12 6	1 12 21	1 12 36	1 12 46	1 12 57	1 13 7	1 13 15	1 13 23	1 13 31	14
16	1 9 30	1 9 46	1 10 2	1 10 18	1 10 27	1 10 35	1 10 44	1 10 52	1 10 59	1 11 7	16
18	1 6 53	1 7 7	1 7 22	1 7 36	1 7 45	1 7 55	1 8 4	1 8 12	1 8 19	1 8 27	18
20	1 3 57	1 4 11	1 4 25	1 4 39	1 4 48	1 4 58	1 5 7	1 5 14	1 5 22	1 5 29	20
22	1 0 47	1 1 0	1 1 13	1 1 26	1 1 35	1 1 45	1 1 54	1 2 1	1 2 8	1 2 15	22
24	0 57 25	0 57 38	0 57 51	0 58 4	0 58 13	0 58 21	0 58 30	0 58 36	0 58 43	0 58 49	24
26	0 53 34	0 53 46	0 53 59	0 54 11	0 54 17	0 54 22	0 54 28	0 54 38	0 54 47	0 54 57	26
28	0 49 36	0 49 48	0 49 59	0 50 11	0 50 16	0 50 22	0 50 27	0 50 35	0 50 44	0 50 52	28
30	0 45 24	0 45 35	0 45 46	0 45 57	0 46 2	0 46 7	0 46 12	0 46 22	0 46 31	0 46 41	30
32	0 41 0	0 41 11	0 41 21	0 41 32	0 41 40	0 41 47	0 41 55	0 42 1	0 42 8	0 42 14	32
34	0 36 27	0 36 37	0 36 46	0 36 56	0 37 3	0 37 10	0 37 17	0 37 24	0 37 30	0 37 37	34
36	0 31 36	0 31 45	0 31 55	0 32 4	0 32 11	0 32 18	0 32 25	0 32 31	0 32 37	0 32 43	36
38	0 26 35	0 26 44	0 26 53	0 27 2	0 27 9	0 27 15	0 27 22	0 27 28	0 27 35	0 27 41	38

40	0 21 26	0 21 35	0 21 43	0 21 52	0 25 58	0 26 5	0 22 11	0 22 17	0 22 23	0 22 29	40
42	0 16 13	0 16 20	0 16 28	0 16 35	0 16 40	0 16 46	0 16 51	0 16 57	0 17 3	0 17 10	42
44	0 10 51	0 10 58	0 11 5	0 11 12	0 11 17	0 11 21	0 11 26	0 11 32	0 11 38	0 11 44	44
46	0 5 24	0 5 29	0 5 35	0 5 40	0 5 48	0 5 57	0 6 5	0 6 7	0 6 10	0 6 12	46
48				0 0 4	0 0 9	0 0 15	0 0 20	0 0 26	0 0 31	0 0 37	48
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
48	0 0 12	0 0 7	0 0 1								
50	0 5 46	0 5 42	0 5 38	0 5 34	0 5 29	0 5 23	0 5 18	0 5 12	0 5 6	0 5 0	50
52	0 11 24	0 11 20	0 11 16	0 11 12	0 11 7	0 11 3	0 10 58	0 10 52	0 10 45	0 10 39	52
54	0 16 59	0 16 56	0 16 52	0 16 49	0 16 45	0 16 40	0 16 36	0 16 30	0 16 25	0 16 19	54
56	0 22 31	0 22 29	0 22 26	0 22 24	0 22 20	0 22 15	0 22 11	0 22 5	0 21 59	0 21 53	56
58	0 28 0	0 27 59	0 27 57	0 27 56	0 27 51	0 27 46	0 27 41	0 27 36	0 27 30	0 27 25	58
60	0 33 23	0 33 22	0 33 21	0 33 20	0 33 16	0 33 11	0 33 7	0 33 1	0 32 56	0 32 50	60
62	0 38 37	0 38 36	0 38 36	0 38 35	0 38 31	0 38 27	0 38 23	0 38 18	0 38 13	0 38 8	62
64	0 43 42	0 43 42	0 43 41	0 43 41	0 43 38	0 43 34	0 43 31	0 43 25	0 43 18	0 43 14	64
66	0 48 36	0 48 36	0 48 37	0 48 37	0 48 34	0 48 30	0 48 27	0 48 21	0 48 16	0 48 10	66
68	0 53 15	0 53 16	0 53 16	0 53 17	0 53 14	0 53 10	0 53 7	0 53 1	0 52 56	0 52 50	68
70	0 57 40	0 57 41	0 57 41	0 57 42	0 57 39	0 57 36	0 57 33	0 57 27	0 57 22	0 57 16	70
72	1 1 45	1 1 47	1 1 48	1 1 50	1 1 47	1 1 44	1 1 41	1 1 35	1 1 28	1 1 21	72
74	1 5 32	1 5 34	1 1 35	1 5 37	1 5 34	1 5 32	1 5 29	1 5 23	1 5 16	1 5 10	74
76	1 8 57	1 8 59	1 9 1	1 9 3	1 9 0	1 8 56	1 8 53	1 8 47	1 8 40	1 8 34	76
78	1 11 57	1 11 59	1 12 1	1 12 3	1 12 0	1 11 58	1 11 55	1 11 49	1 11 42	1 11 36	78
80	1 14 33	1 14 36	1 14 38	1 14 41	1 14 38	1 14 36	1 14 33	1 14 26	1 14 20	1 14 13	80
82	1 16 43	1 16 45	1 16 48	1 16 50	1 16 47	1 16 44	1 16 41	1 16 35	1 16 28	1 16 22	82
84	1 18 26	1 18 29	1 18 33	1 18 36	1 18 33	1 18 30	1 18 27	1 18 20	1 18 13	1 18 6	84
86	1 19 40	1 19 43	1 19 45	1 19 48	1 19 46	1 19 43	1 19 41	1 19 34	1 19 27	1 19 20	86
88	1 20 22	1 20 25	1 20 28	1 20 30	1 20 28	1 20 25	1 20 23	1 20 16	1 20 9	1 20 02	88
90	1 20 38	1 20 41	1 20 44	1 20 47	1 20 45	1 20 43	1 20 41	1 20 34	1 20 27	1 20 20	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

Mean Anomaly 3 Signs.

Apoge ☽ 1° Ti. equat. à ☉.	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	Apoge ☽ 1° Ti. equat. à ☉.
	A.	A.	A.	A.	A.	A.	A.	A.	A.	A.	
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	1 21 28	1 21 30	1 21 32	1 21 30	1 21 29	1 21 27	1 21 20	1 21 12	1 21 5	1 20 53	0
2	1 21 14	1 21 15	1 21 17	1 21 15	1 21 13	1 21 11	1 21 4	1 20 58	1 20 51	1 20 39	2
4	1 20 45	1 20 47	1 20 48	1 20 46	1 20 45	1 20 43	1 20 36	1 20 30	1 20 23	1 20 11	4
6	1 19 59	1 20 1	1 20 2	1 20 1	1 20 0	1 19 59	1 19 52	1 19 46	1 19 39	1 19 27	6
8	1 18 49	1 18 51	1 18 52	1 18 51	1 18 50	1 18 49	1 18 43	1 18 36	1 18 30	1 18 18	8
10	1 17 21	1 17 22	1 17 24	1 17 23	1 17 22	1 17 21	1 17 15	1 17 10	1 17 4	1 16 52	10
12	1 15 37	1 15 38	1 15 40	1 15 39	1 15 39	1 15 38	1 15 32	1 15 26	1 15 20	1 15 9	12
14	1 13 32	1 13 34	1 13 35	1 13 35	1 13 34	1 13 34	1 13 28	1 13 22	1 13 16	1 13 6	14
16	1 11 10	1 11 12	1 11 15	1 11 13	1 11 12	1 11 10	1 11 6	1 11 1	1 10 57	1 10 47	16
18	1 8 29	1 11 31	1 8 33	1 8 33	1 8 32	1 8 32	1 8 27	1 8 23	1 8 18	1 8 9	18
20	1 5 31	1 5 34	1 5 36	1 5 36	1 5 36	1 5 36	1 5 31	1 5 26	1 5 21	1 5 13	20
22	1 3 18	1 3 21	1 2 24	1 2 24	1 2 24	1 2 25	1 2 20	1 2 16	1 2 11	1 2 3	22
24	0 58 53	0 58 56	0 58 50	0 58 54	0 58 57	0 59 1	0 58 57	0 58 53	0 58 49	0 58 42	24
26	0 55 0	0 55 3	0 55 7	0 55 8	0 55 10	0 55 11	0 55 7	0 55 2	0 54 58	0 54 52	26
28	0 50 57	0 51 2	0 51 7	0 51 8	0 51 10	0 51 11	0 51 7	0 51 4	0 51 0	0 50 55	28
30	0 46 44	0 46 48	0 46 51	0 46 53	0 46 54	0 46 56	0 46 53	0 46 51	0 46 48	0 46 43	30
32	0 42 18	0 42 21	0 42 25	0 42 27	0 42 28	0 42 30	0 42 28	0 42 26	0 42 24	0 42 20	32
34	0 37 41	0 37 45	0 37 49	0 37 51	0 37 53	0 37 55	0 37 54	0 37 54	0 37 53	0 37 50	34
36	0 32 48	0 32 52	0 32 57	0 32 59	0 33 2	0 33 4	0 33 3	0 33 3	0 33 2	0 33 0	36
38	0 27 46	0 27 50	0 27 55	0 27 58	0 28 0	0 28 3	0 28 3	0 28 4	0 28 4	0 28 1	38

40	0 22 34	0 22 39	0 22 44	0 22 47	0 22 51	0 22 54	0 22 55	0 22 55	0 22 56	0 22 56	40
42	0 17 15	0 17 20	0 17 25	0 17 29	0 17 33	0 17 37	0 17 39	0 17 41	0 17 43	0 17 44	42
44	0 11 49	0 11 55	0 12 0	0 12 5	0 12 9	0 12 14	0 12 16	0 12 19	0 12 21	0 12 24	44
46	0 6 17	0 6 23	0 6 28	0 6 33	0 6 39	0 6 44	0 6 48	0 6 51	0 6 55	0 6 59	46
48	0 0 42	0 0 48	0 0 53	0 0 59	0 1 4	0 1 10	0 1 14	0 1 19	0 1 23	0 1 28	48
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
50	0 4 55	0 4 51	0 4 46	0 4 39	0 4 33	0 4 26	0 4 19	0 4 13	0 4 6	0 4 1	50
52	0 10 34	0 10 30	0 10 25	0 10 18	0 10 11	0 10 4	0 9 56	0 9 49	0 9 41	0 9 34	52
54	0 16 13	0 16 8	0 16 2	0 15 54	0 15 47	0 15 39	0 15 31	0 15 22	0 15 14	0 15 6	54
56	0 21 47	0 21 40	0 21 34	0 21 26	0 21 19	0 21 11	0 21 3	0 20 54	0 20 45	0 20 35	56
58	0 27 18	0 27 11	0 27 4	0 26 56	0 26 48	0 26 40	0 26 30	0 26 21	0 26 11	0 26 0	58
60	0 32 42	0 32 35	0 32 27	0 32 18	0 32 10	0 32 1	0 31 51	0 31 40	0 31 30	0 31 17	60
62	0 38 0	0 37 52	0 37 44	0 37 34	0 37 25	0 37 15	0 37 4	0 36 53	0 36 43	0 36 28	62
64	0 43 6	0 42 57	0 42 49	0 42 40	0 42 30	0 42 21	0 42 9	0 41 56	0 41 44	0 41 28	64
66	0 48 1	0 47 52	0 47 43	0 47 33	0 47 22	0 47 12	0 47 0	0 46 47	0 46 34	0 46 16	66
68	0 52 41	0 52 33	0 52 24	0 52 12	0 52 1	0 51 49	0 51 36	0 51 22	0 51 9	0 50 50	68
70	0 57 7	0 56 58	0 56 49	0 56 37	0 56 24	0 56 12	0 55 58	0 55 43	0 55 29	0 55 10	70
72	1 1 11	1 1 1	1 0 51	1 0 40	1 0 28	1 0 17	1 0 2	0 59 47	0 59 32	0 59 11	72
74	1 5 1	1 4 51	1 4 42	1 4 29	1 4 15	1 4 2	1 3 46	1 3 30	1 3 14	1 2 53	74
76	1 8 25	1 8 15	1 8 6	1 7 53	1 7 39	1 7 26	1 7 9	1 6 52	1 6 35	1 6 13	76
78	1 11 26	1 11 16	1 11 6	1 10 52	1 10 38	1 10 24	1 10 7	1 9 50	1 9 33	1 9 10	78
80	1 14 3	1 13 53	1 13 43	1 13 29	1 13 15	1 13 1	1 12 43	1 12 25	1 12 7	1 11 44	80
82	1 16 11	1 16 0	1 15 49	1 15 34	1 15 18	1 15 3	1 14 46	1 14 30	1 14 13	1 13 49	82
84	1 17 56	1 17 47	1 17 37	1 17 22	1 17 7	1 16 52	1 16 34	1 16 15	1 15 57	1 15 32	84
86	1 19 10	1 19 0	1 18 50	1 18 35	1 18 19	1 18 4	1 17 45	1 17 27	1 17 8	1 16 43	86
88	1 19 52	1 19 42	1 19 32	1 19 17	1 19 1	1 18 46	1 18 27	1 18 8	1 17 49	1 17 24	88
90	1 20 10	1 20 0	1 19 50	1 19 35	1 19 19	1 19 4	1 18 44	1 18 25	1 18 5	1 17 40	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 3 Signs.

Apoge ☽ 1° Ti. equat. à ☉.	20° A. ° ' "	21° A. ° ' "	22° A. ° ' "	23° A. ° ' "	24° A. ° ' "	25° A. ° ' "	26° A. ° ' "	27° A. ° ' "	28° A. ° ' "	29° A. ° ' "	Apoge ☽ 1° Ti. equat. à ☉.
0	1 20 42	1 20 30	1 20 12	1 19 54	1 19 36	1 19 14	1 18 52	1 18 29	1 18 1	1 17 34	0
2	1 20 27	1 20 15	1 19 57	1 19 39	1 19 21	1 19 0	1 18 37	1 18 14	1 17 47	1 17 20	2
4	1 20 0	1 19 48	1 19 30	1 19 13	1 18 55	1 18 33	1 18 10	1 17 48	1 17 21	1 16 54	4
6	1 19 15	1 19 3	1 18 45	1 18 23	1 18 10	1 17 48	1 17 26	1 17 4	1 16 37	1 16 11	6
8	1 18 7	1 17 55	1 17 38	1 17 21	1 17 4	1 16 42	1 16 20	1 15 58	1 15 32	1 15 5	8
10	1 16 40	1 16 28	1 16 11	1 15 55	1 15 38	1 15 17	1 14 55	1 14 34	1 14 8	1 13 43	10
12	1 14 59	1 14 48	1 14 31	1 14 15	1 13 58	1 13 37	1 13 16	1 12 55	1 12 30	1 12 5	12
14	1 12 55	1 12 45	1 12 29	1 12 13	1 11 57	1 11 37	1 11 17	1 10 57	1 10 33	1 10 9	14
16	1 10 38	1 10 28	1 10 12	1 9 57	1 9 41	1 9 22	1 9 3	1 8 44	1 8 21	1 7 57	16
18	1 8 0	1 7 50	1 7 35	1 7 20	1 7 5	1 6 47	1 6 29	1 6 11	1 5 48	1 5 26	18
20	1 5 4	1 4 56	1 4 42	1 4 28	1 4 14	1 3 56	1 3 39	1 3 21	1 3 0	1 2 38	20
22	1 1 54	1 1 46	1 1 33	1 1 20	1 1 7	1 0 51	1 0 34	1 0 18	0 59 58	0 59 38	22
24	0 58 34	0 58 27	0 58 14	0 58 1	0 57 50	0 57 35	0 57 20	0 57 5	0 56 46	0 56 28	24
26	0 54 45	0 54 39	0 54 27	0 54 16	0 54 4	0 53 50	0 53 37	0 53 23	0 53 6	0 52 49	26
28	0 50 49	0 50 44	0 50 33	0 50 21	0 50 10	0 49 58	0 49 46	0 49 35	0 49 19	0 49 4	28
30	0 46 39	0 46 34	0 46 25	0 46 15	0 46 6	0 45 55	0 45 45	0 45 34	0 45 19	0 45 5	30
32	0 42 16	0 42 12	0 42 4	0 41 57	0 41 49	0 41 39	0 41 30	0 41 20	0 41 8	0 40 56	32
34	0 37 46	0 37 43	0 37 37	0 37 30	0 37 24	0 37 16	0 37 8	0 37 0	0 36 49	0 36 38	34
36	0 32 58	0 32 56	0 32 51	0 32 45	0 32 40	0 32 34	0 32 27	0 32 21	0 32 11	0 32 0	36
38	0 28 0	0 28 0	0 27 56	0 27 53	0 27 49	0 27 45	0 27 40	0 27 36	0 27 29	0 27 23	38

40	0 22 57	0 22 57	0 22 55	0 22 52	0 22 50	0 22 47	0 22 45	0 22 42	0 22 37	0 22 32	40
42	0 17 46	0 17 47	0 17 46	0 17 45	0 17 44	0 17 43	0 17 41	0 17 41	0 17 38	0 17 35	42
44	0 12 26	0 12 29	0 12 30	0 12 31	0 12 32	0 12 32	0 12 33	0 12 33	0 12 33	0 12 32	44
46	0 7 3	0 7 7	0 7 10	0 7 12	0 7 15	0 7 17	0 7 20	0 7 22	0 7 23	0 7 23	46
48	0 1 34	0 1 39	0 1 43	0 1 47	0 1 51	0 1 56	0 2 0	0 2 5	0 2 8	0 2 12	48
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
50	0 3 55	0 3 50	0 3 45	0 3 39	0 3 34	0 3 28	0 3 21	0 3 15	0 3 9	0 3 3	50
52	0 9 27	0 9 20	0 9 13	0 9 7	0 9 0	0 8 51	0 8 43	0 8 34	0 8 26	0 8 18	52
54	0 14 58	0 14 50	0 14 41	0 14 31	0 14 22	0 14 11	0 14 1	0 13 51	0 13 41	0 13 31	54
56	0 20 24	0 20 14	0 20 4	0 19 53	0 19 43	0 19 31	0 19 19	0 19 7	0 18 54	0 18 42	56
58	0 25 48	0 25 36	0 25 24	0 25 12	0 25 0	0 24 46	0 24 31	0 24 16	0 24 1	0 23 47	58
60	0 31 4	0 30 51	0 30 37	0 30 23	0 30 9	0 29 53	0 29 37	0 29 21	0 29 4	0 28 48	60
62	0 36 13	0 35 58	0 35 43	0 35 27	0 35 12	0 34 54	0 34 36	0 34 18	0 33 59	0 33 39	62
64	0 41 13	0 40 57	0 40 40	0 40 23	0 40 6	0 39 46	0 39 26	0 39 6	0 38 45	0 38 23	64
66	0 46 0	0 45 41	0 45 23	0 45 5	0 44 47	0 44 25	0 44 3	0 43 41	0 43 18	0 42 55	66
68	0 50 32	0 50 13	0 49 54	0 49 34	0 49 15	0 48 51	0 48 28	0 48 4	0 47 39	0 47 13	68
70	0 54 50	0 54 31	0 54 10	0 53 48	0 53 27	0 53 2	0 52 37	0 52 12	0 51 45	0 51 18	70
72	0 58 51	0 58 30	0 58 8	0 57 45	0 57 23	0 56 57	0 56 30	0 56 4	0 55 35	0 55 6	72
74	1 2 31	1 2 10	1 1 47	1 1 23	1 1 0	1 0 32	1 0 3	0 59 35	0 59 5	0 58 34	74
76	1 5 50	1 5 28	1 5 4	1 4 39	1 4 15	1 3 46	1 3 16	1 2 47	1 2 15	1 1 43	76
78	1 8 47	1 8 24	1 7 58	1 7 33	1 7 7	1 6 37	1 6 7	1 5 37	1 5 4	1 4 30	78
80	1 11 20	1 10 57	1 10 30	1 10 3	1 9 36	1 9 5	1 8 33	1 8 4	1 7 29	1 6 54	80
82	1 13 26	1 13 2	1 12 35	1 12 8	1 11 41	1 11 9	1 10 38	1 10 6	1 9 31	1 8 55	82
84	1 15 7	1 14 42	1 14 15	1 13 47	1 13 20	1 12 47	1 12 13	1 11 42	1 11 6	1 10 30	84
86	1 16 19	1 15 54	1 15 26	1 14 58	1 14 29	1 13 56	1 13 23	1 12 50	1 12 13	1 11 37	86
88	1 17 0	1 16 34	1 16 6	1 15 37	1 15 9	1 14 36	1 14 3	1 13 30	1 12 53	1 12 16	88
90	1 17 16	1 16 51	1 16 22	1 15 54	1 15 25	1 14 52	1 14 19	1 13 46	1 13 9	1 12 31	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 4 Signs.

Apoge ☽ 1° Ti. equat. à ☉	0° A. ° ′ ″	1° A. ° ′ ″	2° A. ° ′ ″	3° A. ° ′ ″	4° A. ° ′ ″	5° A. ° ′ ″	6° A. ° ′ ″	7° A. ° ′ ″	8° A. ° ′ ″	9° A. ° ′ ″	Apoge ☽ 1° Ti. equat. à ☉
°											°
0	1 17 6	1 16 32	1 15 59	1 15 25	1 14 46	1 14 8	1 13 29	1 12 45	1 12 0	1 11 16	0
2	1 16 52	1 16 18	1 15 44	1 15 11	1 14 32	1 13 54	1 13 15	1 12 31	1 11 48	1 11 4	2
4	1 16 27	1 15 53	1 15 20	1 14 46	1 14 7	1 13 29	1 12 50	1 12 6	1 11 23	1 10 39	4
6	1 15 44	1 15 11	1 14 38	1 14 5	1 13 27	1 12 48	1 12 10	1 11 27	1 10 43	1 10 0	6
8	1 14 39	1 14 6	1 13 34	1 13 1	1 12 24	1 11 46	1 11 9	1 10 26	1 9 44	1 9 1	8
10	1 13 17	1 12 45	1 12 14	1 11 42	1 11 5	1 10 29	1 9 52	1 9 11	1 8 29	1 7 48	10
12	1 11 40	1 11 9	1 10 39	1 10 8	1 9 32	1 8 55	1 8 19	1 7 38	1 6 58	1 6 17	12
14	1 9 45	1 9 15	1 8 44	1 8 14	1 7 39	1 7 4	1 6 29	1 5 50	1 5 10	1 4 31	14
16	1 7 34	1 7 5	1 6 36	1 6 7	1 5 33	1 4 59	1 4 25	1 3 47	1 3 9	1 2 31	16
18	1 5 3	1 4 35	1 4 8	1 3 40	1 3 7	1 2 35	1 2 2	1 1 23	1 0 49	1 0 13	18
20	1 2 17	1 1 51	1 1 24	1 0 58	1 0 27	0 59 56	0 59 25	0 58 50	0 58 15	0 57 40	20
22	0 59 18	0 58 53	0 58 28	0 53 3	0 57 34	0 57 5	0 55 36	0 56 2	0 55 29	0 54 55	22
24	0 56 9	0 55 45	0 55 22	0 54 58	0 54 31	0 54 3	0 53 36	0 53 5	0 52 33	0 52 2	24
26	0 52 32	0 52 10	0 51 49	0 51 27	0 51 1	0 50 35	0 50 10	0 49 41	0 49 11	0 48 42	26
28	0 43 48	0 48 28	0 48 8	0 47 43	0 47 25	0 47 2	0 46 39	0 46 12	0 45 41	0 45 17	28
30	0 44 50	0 44 32	0 44 14	0 43 57	0 43 36	0 43 14	0 42 53	0 42 31	0 42 8	0 41 46	30
32	0 40 44	0 40 28	0 40 12	0 39 56	0 39 37	0 39 17	0 33 58	0 38 36	0 38 15	0 37 53	32
34	0 36 27	0 36 14	0 36 0	0 35 47	0 35 30	0 35 14	0 34 57	0 34 37	0 34 18	0 33 58	34
36	0 31 50	0 31 40	0 31 31	0 31 21	0 31 7	0 30 53	0 30 39	0 30 22	0 30 6	0 29 49	36
38	0 27 16	0 27 7	0 26 57	0 26 48	0 26 36	0 26 25	0 26 13	0 26 0	0 25 46	0 25 33	38

40	0 22 27	0 22 20	0 22 13	0 22 6	0 21 57	0 21 49	0 21 40	0 21 30	0 21 19	0 21 9	40
42	0 17 32	0 17 28	0 17 23	0 17 19	0 17 13	0 17 8	0 17 2	0 16 54	0 16 47	0 16 39	42
44	0 12 30	0 12 28	0 12 27	0 12 25	0 12 22	0 12 19	0 12 16	0 12 11	0 12 7	0 12 2	44
46	0 7 24	0 7 25	0 7 27	0 7 28	0 7 28	0 7 28	0 7 27	0 7 26	0 7 24	0 7 23	46
48	0 2 15	0 2 19	0 2 22	0 2 26	0 2 28	0 2 31	0 2 33	0 2 35	0 2 38	0 2 40	48
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
50	0 2 57	0 2 51	0 2 44	0 2 38	0 2 33	0 2 27	0 2 22	0 2 17	0 2 12	0 2 7	50
52	0 8 10	0 8 1	0 7 53	0 7 44	0 7 35	0 7 27	0 7 18	0 7 9	0 7 1	0 6 5[illegible]	52
54	0 13 21	0 13 10	0 12 58	0 12 47	0 12 35	0 12 24	0 12 12	0 12 0	0 11 48	0 11 36	54
56	0 18 29	0 18 15	0 18 1	0 17 47	0 17 32	0 17 18	0 17 3	0 16 48	0 16 32	0 16 17	56
58	0 23 32	0 23 16	0 23 0	0 22 43	0 22 25	0 22 7	0 21 49	0 21 31	0 21 13	0 20 55	58
60	0 28 31	0 28 12	0 27 54	0 27 35	0 27 14	0 26 52	0 26 31	0 26 9	0 25 48	0 25 2[illegible]	60
62	0 33 20	0 32 59	0 32 38	0 32 17	0 31 54	0 31 30	0 31 7	0 30 42	0 30 17	0 39 52	62
64	0 38 2	0 37 38	0 37 14	0 36 50	0 36 24	0 35 58	0 35 32	0 35 4	0 34 36	0 34 8	64
66	0 42 32	0 42 6	0 41 40	0 41 14	0 40 45	0 40 16	0 39 47	0 39 16	0 38 45	0 38 14	65
68	0 46 48	0 46 20	0 45 51	0 45 23	0 44 52	0 44 21	0 43 50	0 43 16	0 42 43	0 42 9	68
70	0 50 51	0 50 21	0 49 50	0 49 20	0 48 46	0 48 12	0 47 38	0 47 2	0 46 25	0 45 49	70
72	0 54 37	0 54 4	0 53 31	0 52 58	0 52 23	0 51 47	0 51 12	0 50 33	0 49 53	0 49 14	72
74	0 58 4	0 57 29	0 56 54	0 56 19	0 55 42	0 55 5	0 54 28	0 53 47	0 53 6	0 52 25	74
76	1 1 11	1 0 35	0 59 58	0 59 22	0 58 43	0 58 4	0 57 25	0 56 42	0 56 0	0 55 16	76
78	1 3 57	1 3 19	1 2 41	1 2 3	1 1 23	1 0 42	1 0 2	0 59 17	0 58 32	0 57 47	78
80	1 6 20	1 5 41	1 5 1	1 4 22	1 3 40	1 2 58	1 2 16	1 1 30	1 0 43	0 59 57	80
82	1 8 20	1 7 40	1 7 0	1 6 20	1 5 37	1 4 53	1 4 10	1 3 22	1 2 35	1 1 47	82
84	1 9 53	1 9 12	1 8 31	1 7 50	1 7 6	1 6 22	1 5 38	1 4 50	1 4 1	1 3 13	84
86	1 11 0	1 10 19	1 9 37	1 8 56	1 8 11	1 7 26	1 6 41	1 5 52	1 5 3	1 4 14	86
88	1 11 39	1 10 57	1 10 16	1 9 34	1 8 48	1 8 3	1 7 17	1 6 27	1 5 38	1 4 48	88
90	1 11 54	1 11 12	1 10 30	1 9 48	1 9 3	1 8 17	1 7 32	1 6 42	1 5 52	1 5 2	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

Mean Anomaly 4 Signs.

Apoge ☽ 1° Ti. equat. à ☉.	10° A.	11° A.	12° A.	13° A.	14° A.	15° A.	16° A.	17° A.	18° A.	19° A.	Apoge ☽ 1° Ti. equat. à ☉.
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	1 10 26	1 9 36	1 8 46	1 7 52	1 6 57	1 6 3	1 5 3	1 4 3	1 3 3	1 1 57	0
2	1 10 14	1 9 24	1 8 34	1 7 40	1 6 46	1 5 52	1 4 52	1 3 51	1 2 51	1 1 46	2
4	1 9 50	1 9 0	1 8 11	1 7 17	1 6 22	1 5 28	1 4 29	1 3 29	1 2 30	1 1 25	4
6	1 9 11	1 8 23	1 7 34	1 6 41	1 5 47	1 4 54	1 3 54	1 2 55	1 1 55	1 0 51	6
8	1 8 12	1 7 24	1 6 35	1 5 42	1 4 50	1 3 57	1 2 59	1 2 0	1 1 2	0 59 59	8
10	1 7 0	1 6 13	1 5 25	1 4 33	1 3 41	1 2 49	1 1 52	1 0 55	0 59 58	0 58 55	10
12	1 5 31	1 4 46	1 4 0	1 3 9	1 2 17	1 1 26	1 0 30	0 59 35	0 58 39	0 57 38	12
14	1 3 46	1 3 1	1 2 16	1 1 26	1 0 37	0 59 47	0 58 53	0 57 59	0 57 5	0 56 6	14
16	1 1 48	1 1 4	1 0 21	0 59 33	0 58 46	0 57 58	0 57 5	0 56 13	0 55 20	0 54 23	16
18	0 59 31	0 58 48	0 58 6	0 57 21	0 56 36	0 55 51	0 55 0	0 54 8	0 53 17	0 52 22	18
20	0 57 0	0 56 20	0 55 40	0 54 57	0 54 13	0 53 30	0 52 41	0 51 53	0 51 4	0 50 12	20
22	0 54 17	0 53 40	0 53 2	0 52 20	0 51 39	0 50 57	0 50 11	0 49 25	0 48 39	0 47 49	22
24	0 51 26	0 50 51	0 50 15	0 49 36	0 48 56	0 48 17	0 47 33	0 46 49	0 46 5	0 45 18	24
26	0 48 9	0 47 35	0 47 2	0 46 26	0 45 49	0 45 13	0 44 32	0 43 51	0 43 10	0 42 27	26
28	0 44 47	0 44 16	0 43 46	0 43 14	0 42 40	0 42 4	0 41 26	0 40 47	0 40 9	0 39 29	28
30	0 41 16	0 40 47	0 40 17	0 39 46	0 39 14	0 38 43	0 38 8	0 37 34	0 36 59	0 36 22	30
32	0 37 28	0 37 3	0 36 38	0 36 10	0 35 42	0 35 14	0 34 43	0 34 11	0 33 40	0 33 7	32
34	0 33 36	0 33 13	0 32 51	0 32 26	0 32 2	0 31 37	0 31 9	0 30 41	0 30 13	0 29 43	34
36	0 29 30	0 29 10	0 28 51	0 28 30	0 28 8	0 27 47	0 27 23	0 27 0	0 26 35	0 26 9	36
38	0 25 17	0 25 1	0 24 45	0 24 27	0 24 9	0 23 51	0 23 31	0 23 10	0 22 50	0 22 28	38

40	0 20 57	0 20 44	0 20 32	0 20 17	0 20 3	0 19 48	0 19 34	0 19 16	0 19 0	0 18 42	40
42	0 16 30	0 16 20	0 16 11	0 16 0	0 15 50	0 15 39	0 15 27	0 15 16	0 15 4	0 14 51	42
44	0 11 57	0 11 52	0 11 47	0 11 40	0 11 33	0 11 26	0 11 18	0 11 10	0 11 2	0 10 53	44
46	0 7 21	0 7 20	0 7 18	0 7 15	0 7 11	0 7 8	0 7 5	0 7 1	0 6 58	0 6 53	46
48	0 2 41	0 2 43	0 2 44	0 2 45	0 2 46	0 2 47	0 2 48	0 2 49	0 2 50	0 2 49	48
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
50	0 2 2	0 1 57	0 1 52	0 1 47	0 1 42	0 1 37	0 1 32	0 1 27	0 1 22	0 1 20	50
52	0 6 44	0 6 36	0 6 28	0 6 18	0 6 7	0 5 57	0 5 48	0 5 40	0 5 31	0 5 25	52
54	0 11 24	0 11 12	0 11 0	0 10 47	0 10 34	0 10 21	0 10 7	0 9 53	0 9 39	0 9 27	54
56	0 16 2	0 15 46	0 15 31	0 15 14	0 14 57	0 14 40	0 14 22	0 14 4	0 13 46	0 13 29	56
58	0 20 35	0 20 14	0 19 56	0 19 35	0 19 14	0 18 53	0 18 32	0 18 10	0 17 49	0 17 27	58
60	0 25 4	0 24 41	0 24 19	0 23 54	0 23 29	0 23 4	0 22 38	0 22 12	0 21 46	0 21 21	60
62	0 29 26	0 29 0	0 28 33	0 28 4	0 27 36	0 27 7	0 26 38	0 26 9	0 25 40	0 25 9	62
64	0 33 39	0 33 30	0 32 40	0 32 8	0 31 36	0 31 4	0 30 31	0 29 58	0 29 25	0 28 50	64
66	0 37 42	0 37 9	0 36 37	0 36 1	0 35 25	0 34 49	0 34 13	0 33 36	0 33 0	0 32 21	66
68	0 41 33	0 40 58	0 40 22	0 39 43	0 39 4	0 38 25	0 37 45	0 37 4	0 36 24	0 35 38	68
70	0 45 11	0 44 33	0 43 55	0 43 13	0 42 32	0 41 50	0 41 8	0 40 26	0 39 44	0 38 55	70
72	0 48 33	0 47 53	0 47 12	0 46 27	0 45 43	0 44 58	0 44 11	0 43 24	0 42 37	0 41 48	72
74	0 51 41	0 50 58	0 50 14	0 49 27	0 48 39	0 47 52	0 47 2	0 46 12	0 45 22	0 44 29	74
76	0 54 30	0 53 45	0 52 59	0 52 9	0 51 19	0 50 29	0 49 37	0 48 44	0 47 52	0 46 56	76
78	0 56 59	0 56 11	0 55 23	0 54 31	0 53 39	0 52 47	0 51 53	0 50 58	0 50 4	0 49 6	78
80	0 59 8	0 58 18	0 57 29	0 56 35	0 55 41	0 54 47	0 53 51	0 52 54	0 51 58	0 50 58	80
82	1 0 56	1 0 5	0 59 14	0 58 19	0 57 23	0 56 28	0 55 30	0 54 33	0 53 35	0 52 33	82
84	1 2 21	1 1 29	1 0 37	0 59 40	0 58 44	0 57 47	0 56 48	0 55 50	0 54 51	0 53 46	84
86	1 3 21	1 2 29	1 1 36	1 0 38	0 59 40	0 58 42	0 57 42	0 56 41	0 55 41	0 54 36	86
88	1 3 55	1 3 1	1 2 8	1 1 10	1 0 11	0 59 13	0 58 13	0 57 12	0 56 12	0 55 6	88
90	1 4 9	1 3 15	1 2 22	1 1 24	1 0 25	0 59 27	0 58 26	0 57 25	0 56 24	0 55 19	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 4 Signs.

Apogé ☽ 1° Ti. equat. à ☉.	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	Apogé ☽ 1° Ti. equat. à ☉.
	A.	A.	A.	A.	A.	A.	A.	A.	A.	A.	
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	1 0 52	0 59 46	0 58 35	0 57 23	0 56 12	0 54 57	0 53 43	0 52 28	0 51 8	0 49 48	0
2	1 0 40	0 59 35	0 58 24	0 57 13	0 56 2	0 54 47	0 53 33	0 52 18	0 50 58	0 49 39	2
4	1 0 20	0 59 15	0 58 5	0 56 56	0 55 46	0 54 31	0 53 16	0 52 1	0 50 42	0 49 22	4
6	0 59 47	0 58 43	0 57 33	0 56 24	0 55 14	0 54 0	0 52 47	0 51 33	0 50 15	0 48 56	6
8	0 58 55	0 57 52	0 56 44	0 55 35	0 54 27	0 53 14	0 52 2	0 50 49	0 49 32	0 48 15	8
10	0 57 53	0 56 50	0 55 43	0 54 35	0 53 28	0 52 17	0 51 5	0 49 54	0 48 39	0 47 23	10
12	0 56 37	0 55 36	0 54 30	0 53 24	0 52 19	0 51 9	0 50 0	0 48 50	0 47 36	0 46 21	12
14	0 55 7	0 54 8	0 53 4	0 52 1	0 50 57	0 49 49	0 48 41	0 47 33	0 46 21	0 45 8	14
16	0 53 26	0 52 29	0 51 28	0 50 27	0 49 26	0 48 20	0 47 13	0 46 7	0 44 56	0 43 44	16
18	0 51 26	0 50 31	0 49 32	0 48 34	0 47 35	0 46 31	0 45 27	0 44 23	0 43 17	0 42 11	18
20	0 49 19	0 48 27	0 47 31	0 46 34	0 45 38	0 44 36	0 43 35	0 42 33	0 41 29	6 40 24	20
22	0 46 59	0 46 9	0 45 16	0 44 23	0 43 30	0 42 31	0 41 33	0 40 34	0 39 32	0 38 31	22
24	0 44 32	0 43 45	0 42 55	0 42 5	0 41 15	0 40 19	0 39 23	0 38 27	0 37 29	0 36 31	24
26	0 41 44	0 41 1	0 40 14	0 39 27	0 38 40	0 37 47	0 36 55	0 36 2	0 35 9	0 34 15	26
28	0 38 49	0 38 9	0 37 26	0 36 44	0 36 1	0 35 12	0 34 22	0 33 33	0 32 43	0 31 52	28
30	0 35 45	0 35 8	0 34 30	0 33 58	0 33 13	0 32 27	0 31 41	0 30 55	0 30 9	0 29 22	30
32	0 32 33	0 32 0	0 31 22	0 30 44	0 30 6	0 29 27	0 28 49	0 28 10	0 27 28	0 26 46	32
34	0 29 14	0 28 44	0 28 10	0 27 37	0 27 3	0 26 28	0 25 54	0 25 19	0 24 41	0 24 4	34
36	0 25 44	0 25 18	0 24 48	0 24 19	0 23 49	0 23 19	0 22 48	0 22 18	0 21 45	0 21 12	36
38	0 22 7	0 21 45	0 21 20	0 20 54	0 20 29	0 29 4	0 19 38	0 19 13	0 18 45	0 18 16	38

40	0 18 25	0 18 7	0 17 46	0 17 26	0 17 5	0 16 44	0 16 23	0 16 2	0 15 38	0 15 15	40
42	0 14 37	0 14 24	0 14 8	0 13 51	0 13 35	0 13 19	0 13 3	0 12 47	0 12 28	0 12 10	42
44	0 10 44	0 10 35	0 10 24	0 10 12	0 10 1	0 9 50	0 9 39	0 9 28	0 9 14	0 9 1	44
46	0 6 49	0 6 44	0 6 37	0 6 30	0 6 23	0 6 17	0 6 11	0 6 5	0 5 57	0 5 48	46
48	0 2 49	0 2 48	0 2 46	0 2 45	0 2 43	0 2 42	0 2 40	0 2 39	0 2 36	0 2 33	48
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
50	0 1 17	0 1 15	0 1 12	0 1 8	0 1 5	0 1 1	0 0 57	0 0 53	0 0 49	0 0 45	50
52	0 5 18	0 5 12	0 5 3	0 4 54	0 4 45	0 4 36	0 4 28	0 4 19	0 4 9	0 4 0	52
54	0 9 16	0 9 4	0 8 50	0 8 37	0 8 23	0 8 10	0 7 56	0 7 43	0 7 29	0 7 14	54
56	0 13 13	0 12 56	0 12 38	0 12 20	0 12 2	0 11 43	0 11 25	0 11 6	0 10 46	0 10 27	56
58	0 17 6	0 16 44	0 16 22	0 16 0	0 15 37	0 15 13	0 14 49	0 14 25	0 14 0	0 13 36	58
60	0 20 56	0 20 31	0 20 3	0 19 35	0 19 7	0 18 39	0 18 10	0 17 42	0 17 12	0 16 43	60
62	0 24 39	0 24 8	0 23 36	0 23 4	0 22 32	0 21 59	0 21 25	0 20 52	0 20 18	0 19 43	62
64	0 28 15	0 27 40	0 27 3	0 26 27	0 25 50	0 25 12	0 24 35	0 23 57	0 23 18	0 22 39	64
66	0 31 41	0 31 2	0 30 22	0 29 41	0 29 1	0 28 19	0 27 36	0 26 54	0 26 10	0 25 26	66
68	0 34 51	0 34 15	0 33 31	0 32 46	0 32 2	0 31 16	0 30 29	0 29 43	0 28 54	0 28 5	68
70	0 38 7	0 37 18	0 36 30	0 35 42	0 34 54	0 34 3	0 33 13	0 32 22	0 31 29	0 30 36	70
72	0 40 58	0 40 8	0 39 17	0 38 25	0 37 34	0 36 40	0 35 45	0 34 51	0 33 55	0 32 56	72
74	0 43 32	0 42 43	0 41 49	0 40 54	0 40 0	0 39 1	0 38 3	0 37 4	0 36 4	0 35 5	74
76	0 46 0	0 45 4	0 44 7	0 43 9	0 42 12	0 41 11	0 40 10	0 39 9	0 38 5	0 37 0	76
78	0 48 7	0 47 9	0 46 9	0 45 9	0 44 9	0 43 5	0 42 1	0 40 57	0 39 50	0 38 44	78
80	0 49 57	0 48 57	0 47 55	0 46 52	0 45 50	0 44 43	0 43 37	0 42 30	0 41 21	0 40 12	80
82	0 51 30	0 50 28	0 49 24	0 48 20	0 47 16	0 46 8	0 45 0	0 43 52	0 42 39	0 41 27	82
84	0 52 41	0 51 36	0 50 31	0 49 25	0 48 20	0 47 10	0 46 0	0 44 52	0 43 38	0 42 25	84
86	0 53 31	0 52 26	0 51 20	0 50 14	0 49 8	0 47 57	0 46 46	0 45 35	0 44 21	0 43 6	86
88	0 54 0	0 52 54	0 51 48	0 50 41	0 49 35	0 48 23	0 47 12	0 46 0	0 44 45	0 43 29	88
90	0 54 13	0 53 8	0 52 1	0 50 53	0 49 46	0 48 34	0 47 22	0 46 10	0 44 55	0 43 39	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 5 Signs.

Apoge ☽ 1° Ti. equat. à ☉	0° A.			1° A.			2° A.			3° A.			4° A.			5° A.			6° A.			7° A.			8° A.			9° A.			Apoge ☽ 1° Ti. equat. à ☉
°	°	'	"	°	'	"	°	'	"	°	'	"	°	'	"	°	'	"	°	'	"	°	'	"	°	'	"	°	'	"	°
0	0	48	28	0	47	4	0	45	41	0	44	17	0	42	50	0	41	22	0	39	55	0	38	23	0	36	52	0	35	20	0
2	0	48	19	0	46	56	0	45	33	0	44	19	0	42	43	0	41	15	0	39	48	0	38	17	0	36	45	0	35	14	2
4	0	48	3	0	46	40	0	45	18	0	43	55	0	42	28	0	41	1	0	39	34	0	38	3	0	36	32	0	35	1	4
6	0	47	38	0	46	16	0	44	54	0	43	32	0	42	6	0	40	39	0	39	13	0	37	43	0	36	13	0	34	43	6
8	0	46	58	0	45	37	0	44	16	0	42	55	0	41	30	0	40	5	0	38	40	0	37	11	0	35	43	0	34	14	8
10	0	46	8	0	44	48	0	43	28	0	42	8	0	40	45	0	39	23	0	38	0	0	36	32	0	35	5	0	33	37	10
12	0	45	7	0	43	49	0	42	32	0	41	14	0	39	52	0	38	31	0	37	9	0	35	44	0	34	19	0	32	53	12
14	0	43	56	0	42	40	0	41	24	0	40	8	0	38	49	0	37	29	0	36	10	0	34	47	0	33	24	0	32	1	14
16	0	42	33	0	41	19	0	40	5	0	38	51	0	37	35	0	36	20	0	35	4	0	33	43	0	32	22	0	31	2	16
18	0	41	5	0	39	54	0	38	44	0	37	33	0	36	19	0	35	4	0	33	50	0	32	32	0	31	14	0	29	56	18
20	0	39	20	0	38	12	0	37	5	0	35	57	0	34	46	0	33	36	0	32	25	0	31	10	0	29	56	0	28	41	20
22	0	37	29	0	36	25	0	35	20	0	34	16	0	33	8	0	32	0	0	30	52	0	29	41	0	28	31	0	27	20	22
24	0	35	33	0	34	31	0	33	30	0	32	28	0	31	24	0	30	21	0	29	17	0	28	10	0	27	2	0	25	55	24
26	0	33	20	0	32	22	0	31	25	0	30	27	0	29	27	0	28	27	0	27	27	0	26	24	0	25	21	0	24	18	26
28	0	31	2	0	30	9	0	29	16	0	28	23	0	27	27	0	26	31	0	25	35	0	24	36	0	23	38	0	22	39	28
30	0	28	36	0	27	47	0	26	57	0	26	8	0	25	17	0	24	26	0	23	35	0	22	40	0	21	46	0	20	51	30
32	0	26	4	0	25	19	0	24	35	0	23	50	0	23	3	0	22	17	0	21	30	0	20	41	0	19	51	0	19	2	32
34	0	23	26	0	22	46	0	22	7	0	21	27	0	20	45	0	20	3	0	19	21	0	18	36	0	17	52	0	17	7	34
36	0	20	39	0	20	4	0	19	29	0	18	54	0	18	18	0	17	42	0	17	6	0	16	26	0	15	46	0	15	6	36
38	0	17	48	0	17	18	0	16	48	0	16	18	0	15	47	0	15	15	0	14	44	0	14	10	0	13	37	0	13	3	38

40	0 14 51	0 14 26	0 14 2	0 13 37	0 13 11	0 12 44	0 12 18	0 11 50	0 11 23	0 10 55	40
42	0 11 51	0 11 31	0 11 12	0 10 52	0 10 31	0 10 11	0 9 50	0 9 29	0 9 7	0 8 46	42
44	0 8 47	0 8 33	0 8 18	0 8 4	0 7 49	0 7 35	0 7 20	0 7 4	0 6 48	0 6 32	44
46	0 5 40	0 5 31	0 5 23	0 5 14	0 5 5	0 4 56	0 4 47	0 4 37	0 4 27	0 4 17	46
48	0 2 30	0 2 27	0 2 25	0 2 22	0 2 18	0 2 15	0 2 11	0 2 7	0 2 4	0 2 0	48
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
50	0 0 40	0 0 37	0 0 35	0 0 32	0 0 29	0 0 26	0 0 23	0 0 22	0 0 21	0 0 20	50
52	0 3 50	0 3 42	0 3 34	0 3 26	0 3 17	0 3 8	0 2 59	0 2 52	0 2 44	0 2 37	52
54	0 7 0	0 6 46	0 6 31	0 6 17	0 6 3	0 5 49	0 5 35	0 5 22	0 5 8	0 4 55	54
56	0 10 7	0 9 47	0 9 28	0 9 8	0 8 48	0 8 29	0 8 9	0 7 50	0 7 31	0 7 12	56
58	0 13 11	0 12 46	0 12 22	0 11 57	0 11 32	0 11 6	0 10 41	0 10 15	0 9 50	0 9 24	58
60	0 16 13	0 15 42	0 15 12	0 14 41	0 14 11	0 13 40	0 13 10	0 12 39	0 12 7	0 11 36	60
62	0 19 9	0 18 33	0 17 58	0 17 22	0 16 46	0 16 11	0 15 35	0 14 58	0 14 20	0 13 43	62
64	0 22 0	0 21 19	0 20 38	0 19 57	0 19 16	0 18 35	0 17 54	0 17 11	0 16 29	0 15 46	64
66	0 24 42	0 23 57	0 23 11	0 22 26	0 21 40	0 20 54	0 20 8	0 19 20	0 18 32	0 17 44	66
68	0 27 16	0 26 26	0 25 37	0 24 47	0 23 56	0 23 5	0 22 14	0 21 21	0 20 29	0 19 36	68
70	0 29 43	0 28 49	0 27 55	0 27 1	0 26 5	0 25 10	0 24 14	0 23 17	0 22 19	0 21 22	70
72	0 31 59	0 31 1	0 30 3	0 29 5	0 28 6	0 27 6	0 26 7	0 25 5	0 24 2	0 23 0	72
74	0 34 5	0 33 3	0 32 2	0 31 0	0 29 56	0 28 52	0 27 48	0 26 42	0 25 37	0 24 31	74
76	0 35 56	0 34 51	0 33 47	0 32 42	0 31 35	0 30 28	0 29 21	0 28 12	0 27 2	0 25 53	76
78	0 37 37	0 36 29	0 35 22	0 34 14	0 33 3	0 31 53	0 30 42	0 29 29	0 28 17	0 27 4	78
80	0 39 3	0 37 53	0 36 43	0 35 33	0 34 20	0 33 6	0 31 53	0 30 38	0 29 22	0 28 7	80
82	0 40 14	0 39 2	0 37 51	0 36 39	0 35 24	0 34 8	0 32 53	0 31 36	0 30 18	0 29 1	82
84	0 41 11	0 39 57	0 38 44	0 37 30	0 36 13	0 34 56	0 33 39	0 32 20	0 31 0	0 29 41	84
86	0 41 52	0 40 37	0 39 21	0 38 6	0 36 48	0 35 29	0 34 11	0 32 50	0 31 30	0 30 9	86
88	0 42 14	0 41 0	0 39 43	0 38 28	0 37 9	0 35 50	0 34 31	0 33 9	0 31 48	0 30 26	88
90	0 42 24	0 41 8	0 39 52	0 38 36	0 37 17	0 35 57	0 34 38	0 33 16	0 31 54	0 30 32	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 5 Signs.

Apoge ☽ 1° Ti. equat. à ☉.	10° A.	11° A.	12° A.	13° A.	14° A.	15° A.	16° A.	17° A.	18° A.	19° A.	Apoge ☽ 1° Ti. equat. à ☉.
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	°
0	0 33 45	0 32 11	0 30 36	0 28 58	0 27 20	0 25 42	0 24 2	0 22 22	0 20 42	0 19 0	0
2	0 33 40	0 32 5	0 30 31	0 28 53	0 27 15	0 25 37	0 23 57	0 22 18	0 20 38	0 18 56	2
4	0 33 27	0 31 54	0 30 20	0 28 43	0 27 5	0 25 28	0 23 49	0 22 10	0 20 31	0 18 50	4
6	0 33 10	0 31 37	0 30 4	0 28 28	0 26 51	0 25 15	0 23 37	0 21 58	0 20 20	0 18 40	6
8	0 32 42	0 31 10	0 29 38	0 28 4	0 26 29	0 24 55	0 23 18	0 21 40	0 20 3	0 18 24	8
10	0 32 7	0 30 37	0 29 7	0 27 34	0 26 0	0 24 27	0 22 52	0 21 17	0 19 42	0 18 5	10
12	0 31 25	0 29 58	0 28 30	0 26 59	0 25 27	0 23 56	0 22 23	0 20 49	0 19 16	0 17 41	12
14	0 30 36	0 29 10	0 27 45	0 26 16	0 24 47	0 23 18	0 21 47	0 20 17	0 18 46	0 17 14	14
16	0 29 39	0 28 15	0 26 52	0 25 25	0 23 58	0 22 32	0 21 5	0 19 38	0 18 11	0 16 41	16
18	0 28 36	0 27 17	0 25 57	0 24 34	0 23 10	0 21 47	0 20 23	0 19 0	0 17 35	0 16 8	18
20	0 27 25	0 26 8	0 24 52	0 23 32	0 22 12	0 20 52	0 19 31	0 18 10	0 16 49	0 15 26	20
22	0 26 7	0 24 54	0 23 41	0 22 25	0 21 10	0 19 54	0 18 37	0 17 19	0 16 2	0 14 43	22
24	0 24 46	0 23 37	0 22 28	0 21 16	0 20 4	0 18 52	0 17 39	0 16 26	0 15 13	0 13 58	24
26	0 23 14	0 22 9	0 21 5	0 19 57	0 18 50	0 17 42	0 16 34	0 15 25	0 14 17	0 13 6	26
28	0 21 39	0 20 38	0 19 38	0 18 35	0 17 33	0 16 30	0 15 26	0 14 23	0 13 19	0 12 13	28
30	0 19 56	0 19 1	0 18 6	0 17 8	0 16 11	0 15 13	0 14 14	0 13 16	0 12 17	0 11 16	30
32	0 18 11	0 17 21	0 16 30	0 15 38	0 14 45	0 13 53	0 13 0	0 12 6	0 11 12	0 10 16	32
34	0 16 22	0 15 36	0 14 51	0 14 4	0 13 18	0 12 31	0 11 43	0 10 54	0 10 6	0 9 16	34
36	0 14 26	0 13 47	0 13 7	0 12 26	0 11 44	0 11 3	0 10 20	0 9 38	0 8 55	0 8 10	36
38	0 12 29	0 11 54	0 11 20	0 10 44	0 10 8	0 9 32	0 8 55	0 8 19	0 7 42	0 7 4	38

40	0 10 26	0 9 58	0 9 29	0 8 59	0 8 29	0 7 59	0 7 29	0 6 58	0 6 28	0 5 50	40
42	0 8 23	0 8 0	0 7 36	0 7 12	0 6 47	0 6 23	0 6 0	0 5 35	0 5 11	0 4 45	42
44	0 6 15	0 5 58	0 5 41	0 5 23	0 5 5	0 4 47	0 4 29	0 4 11	0 3 53	0 3 34	44
46	0 4 6	0 3 56	0 3 45	0 3 33	0 3 21	0 3 9	0 2 57	0 2 46	0 2 34	0 2 21	46
48	0 1 55	0 1 50	0 1 45	0 1 40	0 1 35	0 1 30	0 1 25	0 1 19	0 1 14	0 1 8	48
	S.	S.	S.	S.	S.	S.	S.	S.	S.	S.	
50	0 0 18	0 0 17	0 0 15	0 0 14	0 0 14	0 0 13	0 0 11	0 0 9	0 0 7	0 0 7	50
52	0 2 29	0 2 22	0 2 14	0 2 7	0 2 0	0 1 52	0 1 44	0 1 36	0 1 28	0 1 21	52
54	0 4 41	0 4 26	0 4 12	0 4 0	0 3 46	0 3 32	0 3 18	0 3 3	0 2 49	0 2 35	54
56	0 6 51	0 6 31	0 6 10	0 5 50	0 5 30	0 5 10	0 4 50	0 4 29	0 4 9	0 3 48	56
58	0 8 58	0 8 31	0 8 5	0 7 39	0 7 13	0 6 47	0 6 21	0 5 54	0 5 28	0 5 1	58
60	0 11 3	0 10 31	0 9 58	0 9 26	0 8 53	0 8 21	0 7 50	0 7 18	0 6 47	0 6 13	60
62	0 13 5	0 12 26	0 11 48	0 11 10	0 10 32	0 9 54	0 9 17	0 8 39	0 8 2	0 7 21	62
64	0 15 2	0 14 18	0 13 34	0 12 50	0 12 7	0 11 23	0 10 40	0 9 57	0 9 14	0 8 28	64
66	0 16 55	0 16 6	0 15 17	0 14 28	0 13 38	0 12 49	0 12 0	0 11 10	0 10 21	0 9 29	66
68	0 18 42	0 17 49	0 16 55	0 16 0	0 15 6	0 14 11	0 13 16	0 12 21	0 11 26	0 10 29	68
70	0 20 24	0 19 25	0 18 27	0 17 27	0 16 28	0 15 28	0 14 28	0 13 28	0 12 28	0 11 26	70
72	0 21 57	0 20 55	0 19 52	0 18 48	0 17 44	0 16 40	0 15 35	0 14 30	0 13 25	0 12 18	72
74	0 23 24	0 22 17	0 21 10	0 20 2	0 18 53	0 17 45	0 16 36	0 15 26	0 14 17	0 13 6	74
76	0 24 42	0 23 32	0 22 21	0 21 9	0 19 57	0 18 45	0 17 32	0 16 18	0 15 5	0 13 50	76
78	0 25 50	0 24 37	0 23 23	0 22 8	0 20 52	0 19 37	0 18 20	0 17 3	0 15 46	0 14 28	78
80	0 26 50	0 25 34	0 24 17	0 23 0	0 21 41	0 20 23	0 19 3	0 17 42	0 16 22	0 15 1	80
82	0 27 42	0 26 23	0 25 4	0 23 44	0 22 23	0 21 3	0 19 40	0 18 18	0 16 55	0 15 32	82
84	0 28 20	0 26 59	0 25 38	0 24 15	0 22 53	0 21 30	0 20 5	0 18 40	0 17 15	0 15 49	84
86	0 28 47	0 27 24	0 26 2	0 24 38	0 23 15	0 21 51	0 20 2[illegible]	0 18 58	0 17 31	0 16 4	86
88	0 29 3	0 27 40	0 26 17	0 24 52	0 23 28	0 22 3	0 20 3[illegible]	0 19 9	0 17 42	0 16 14	88
90	0 29 9	0 27 46	0 26 23	0 24 58	0 23 33	0 22 8	0 20 41	0 19 13	0 17 46	0 16 18	90

Reduction *of the* Mean *to the* true Elliptic Equation ☽.

MEAN ANOMALY 5 Signs.

Apogé ☽ 1° Ti. equat. à ☉.	20° A. ° ' "	21° A. ° ' "	22° A. ° ' "	23° A. ° ' "	24° A. ° ' "	25° A. ° ' "	26° A. ° ' "	27° A. ° ' "	28° A. ° ' "	29° A. ° ' "	Apogé ☽ 1° Ti. equat. à ☉.
°											°
0	0 17 18	0 15 36	0 13 53	0 12 11	0 10 28	0 8 43	0 7 0	0 5 14	0 3 29	0 1 45	0
2	0 17 15	0 15 33	0 13 51	0 12 8	0 10 26	0 8 42	0 6 57	0 5 13	0 3 29	0 1 44	2
4	0 17 9	0 15 28	0 13 46	0 12 5	0 10 23	0 8 39	0 6 55	0 5 11	0 3 27	0 1 44	4
6	0 17 0	0 15 19	0 13 38	0 11 58	0 10 17	0 8 34	0 6 52	0 5 9	0 3 26	0 1 43	6
8	0 16 46	0 15 7	0 13 27	0 11 48	0 10 8	0 8 27	0 6 46	0 5 5	0 3 23	0 1 42	8
10	0 16 28	0 14 51	0 13 13	0 11 36	0 9 58	0 8 18	0 6 38	0 4 58	0 3 19	0 1 39	10
12	0 16 7	0 14 32	0 12 56	0 11 21	0 9 45	0 8 7	0 6 30	0 4 52	0 3 15	0 1 37	12
14	0 15 41	0 14 9	0 12 36	0 11 2	0 9 29	0 7 54	0 6 19	0 4 44	0 3 9	0 1 35	14
16	0 15 11	0 13 41	0 12 11	0 10 41	0 9 11	0 7 39	0 6 7	0 4 35	0 3 3	0 1 32	16
18	0 14 41	0 13 14	0 11 47	0 10 20	0 8 53	0 7 24	0 5 56	0 4 27	0 2 58	0 1 29	18
20	0 14 3	0 12 40	0 11 17	0 9 54	0 8 31	0 7 6	0 5 40	0 4 15	0 2 50	0 1 25	20
22	0 13 24	0 12 5	0 10 46	0 9 27	0 8 8	0 6 46	0 5 24	0 4 2	0 2 41	0 1 21	22
24	0 12 43	0 11 28	0 10 13	0 8 57	0 7 42	0 6 25	0 5 7	0 3 50	0 2 33	0 1 17	24
26	0 11 56	0 10 45	0 9 34	0 8 24	0 7 13	0 6 1	0 4 48	0 3 36	0 2 24	0 1 12	26
28	0 11 7	0 10 1	0 8 55	0 7 49	0 6 44	0 5 36	0 4 29	0 3 21	0 2 14	0 1 7	28
30	0 10 15	0 9 14	0 8 14	0 7 13	0 6 13	0 5 10	0 4 8	0 3 5	0 2 3	0 1 2	30
32	0 9 21	0 8 25	0 7 30	0 6 35	0 5 40	0 4 43	0 3 46	0 2 50	0 1 53	0 0 57	32
34	0 8 25	0 7 35	0 6 45	0 5 56	0 5 6	0 4 15	0 3 24	0 2 33	0 1 42	0 0 51	34
36	0 7 26	0 6 41	0 5 57	0 5 14	0 4 30	0 3 45	0 3 0	0 2 15	0 1 30	0 0 45	36
[illegible]	0 6 [illegible]	0 5 47	0 5 0	0 4 32	0 3 54	0 3 15	0 2 36	0 1 57	0 1 18	0 0 29	38

40	0	5	23	0	4	51	0	4	19	0	3	48	0	3	10	0	2	44	0	2	11	0	1	39	0	1	6	0	0	33	40
42	0	4	19	0	3	53	0	3	28	0	3	2	0	2	37	0	2	11	0	1	46	0	1	20	0	0	53	0	0	27	42
44	0	3	14	0	2	55	0	2	36	0	2	16	0	1	57	0	1	38	0	1	19	0	1	0	0	0	40	0	0	20	44
46	0	2	8	0	1	55	0	1	43	0	1	30	0	1	18	0	1	5	0	0	53	0	0	40	0	0	27	0	0	13	46
48	0	1	1	0	0	55	0	0	49	0	0	43	0	0	37	0	0	31	0	0	25	0	0	19	0	0	13	0	0	6	48
		S.			S.			S.			S.			S.			S.			S.			S.			S.			S.		
50	0	0	6	0	0	6	0	0	6	0	0	5	0	0	5	0	0	4	0	0	3	0	0	2	0	0	1	0	0	1	50
52	0	1	15	0	1	8	0	1	1	0	0	53	0	0	46	0	0	38	0	0	31	0	0	23	0	0	15	0	0	8	52
54	0	2	22	0	2	8	0	1	54	0	1	40	0	1	26	0	1	12	0	0	57	0	0	43	0	0	29	0	0	14	54
56	0	3	28	0	3	7	0	2	46	0	2	26	0	2	5	0	1	44	0	1	24	0	1	3	0	0	42	0	0	21	56
58	0	4	33	0	4	6	0	3	39	0	3	11	0	2	44	0	2	17	0	1	49	0	1	22	0	0	55	0	0	27	58
60	0	5	38	0	5	4	0	4	30	0	3	57	0	3	23	0	2	49	0	2	15	0	1	41	0	1	7	0	0	33	60
62	0	6	41	0	6	0	0	5	20	0	4	40	0	4	0	0	3	20	0	2	40	0	2	0	0	1	20	0	0	40	62
64	0	7	41	0	6	55	0	6	9	0	5	22	0	4	36	0	3	50	0	3	4	0	2	18	0	1	32	0	0	46	64
66	0	8	38	0	7	46	0	6	54	0	6	2	0	5	10	0	4	19	0	3	28	0	2	37	0	1	45	0	0	52	66
68	0	9	31	0	8	34	0	7	37	0	6	40	0	5	43	0	4	46	0	3	50	0	2	53	0	1	55	0	0	58	68
70	0	10	23	0	9	21	0	8	19	0	7	17	0	6	15	0	5	13	0	4	10	0	3	8	0	2	5	0	1	3	70
72	0	11	12	0	10	5	0	8	58	0	7	51	0	6	44	0	5	37	0	4	30	0	3	23	0	2	15	0	1	8	72
74	0	11	56	0	10	45	0	9	34	0	8	22	0	7	11	0	6	0	0	4	48	0	3	36	0	2	24	0	1	12	74
76	0	12	35	0	11	20	0	10	5	0	8	49	0	7	34	0	6	19	0	5	3	0	3	48	0	2	32	0	1	16	76
78	0	13	10	0	11	52	0	10	33	0	9	15	0	7	56	0	6	37	0	5	17	0	3	58	0	2	39	0	1	19	78
80	0	13	40	0	12	19	0	10	57	0	9	36	0	8	14	0	6	52	0	5	29	0	4	7	0	2	45	0	1	22	80
82	0	14	8	0	12	45	0	11	19	0	9	54	0	8	28	0	7	3	0	5	39	0	4	14	0	2	49	0	1	25	82
84	0	14	24	0	12	58	0	11	32	0	10	6	0	8	42	0	7	14	0	5	48	0	4	22	0	2	55	0	1	27	84
86	0	14	37	0	13	10	0	11	43	0	10	17	0	8	50	0	7	22	0	5	54	0	4	26	0	2	57	0	1	29	86
88	0	14	47	0	13	19	0	11	51	0	10	23	0	8	55	0	7	26	0	5	58	0	4	29	0	2	59	0	1	30	88
90	0	14	51	0	13	23	0	11	54	0	10	26	0	8	57	0	7	28	0	5	58	0	4	29	0	2	59	0	1	30	90

TABLE *of* Constant Logarithms *for the* Elliptic Equation *of the* Moon.

☽ Apo. 1° Equ. à ☉.	0 Signs 6	1 Signs 7	2 Signs 8	☽ Apo. 1° Equ. à ☉.
0	9.941912	9.946292	9.956339	30
1	9.941917	9.946571	9.956675	29
2	9.941932	9.946857	9.957007	28
3	9.941958	9.947149	9.957330	27
4	9.941994	9.947448	9.957653	26
5	9.942040	9.947752	9.957968	25
6	9.942096	9.948062	9.958275	24
7	9.942163	9.948377	9.958575	23
8	9 942239	9.948698	9.958867	22
9	9.942326	9.949023	9.959151	21
10	9.942422	9.949353	9.959426	20
11	9.942529	9.949687	9.959691	19
12	9.942645	9.950025	9.959946	18
13	9.942771	9.950367	9.960191	17
14	9.942907	9.950712	9.960425	16
15	9.943053	9.951059	9.960648	15
16	9.943208	9.951409	9.960858	14
17	9.943372	9.951761	9.961056	13
18	9.943545	9.952115	9.961242	12
19	9.943728	9.952470	9.961414	11
20	9.943919	9.952827	9.961573	10
21	9.944120	9.953183	9.961717	9
22	9.944329	9.953540	9.961848	8
23	9.944546	9.953896	9.961963	7
24	9.944772	9.954251	9.962064	6
25	9.945006	9.954605	9.962150	5
26	9.945248	9.954957	9.962221	4
27	9.945498	9.955307	9.962276	3
28	9.945755	9.955655	9.962315	2
29	9.946020	9.955999	9.962339	1
30	9.946292	9.956339	9.962347	0
	11 Signs 5	10 Signs 4	9 Signs 3	

EQUATION *to be applied to* Half Mean Anomaly ☽

MEAN ANOMALY.

Signs o. A D D.

Log.	9.942		9.947		9.952		9.957		9.962	
°	′	″	′	″	′	″	′	″	′	″
0	0	0	0	0	0	0	0	0	0	0
1	0	4	0	3	0	3	0	2	0	2
2	0	8	0	7	0	5	0	4	0	3
3	0	12	0	10	0	8	0	6	0	5
4	0	16	0	13	0	11	0	9	0	7
5	0	20	0	16	0	13	0	11	0	8
6	0	24	0	20	0	16	0	13	0	10
7	0	28	0	23	0	19	0	15	0	12
8	0	31	0	26	0	21	0	17	0	13
9	0	35	0	29	0	24	0	19	0	15
10	0	39	0	33	0	27	0	21	0	17
11	0	43	0	36	0	29	0	23	0	18
12	0	46	0	39	0	32	0	25	0	20
13	0	50	0	42	0	34	0	28	0	21
14	0	54	0	45	0	37	0	30	0	23
15	0	57	0	48	0	39	0	32	0	24
16	1	1	0	51	0	42	0	33	0	26
17	1	4	0	54	0	44	0	35	0	27
18	1	8	0	57	0	46	0	37	0	29
19	1	11	0	59	0	48	0	39	0	30
20	1	14	1	2	0	51	0	41	0	32
21	1	18	1	4	0	53	0	42	0	33
22	1	21	1	7	0	55	0	44	0	34
23	1	24	1	9	0	57	0	46	0	36
24	1	26	1	12	0	59	0	47	0	37
25	1	29	1	14	1	1	0	49	0	38
26	1	32	1	17	1	3	0	50	0	39
27	1	34	1	19	1	4	0	52	0	40
28	1	37	1	21	1	6	0	53	0	41
29	1	39	1	23	1	7	0	54	0	42
30	1	42	1	25	1	9	0	55	0	43

EQUATION *to be applied to* Half Mean Anomaly ☽.

MEAN ANOMALY.

Sign 1. A D D.

Log.	9·942		9·947		9·952		9·957		9·962	
°	′	″	′	″	′	″	′	″	′	″
0	1	42	1	25	1	9	0	55	0	43
1	1	44	1	27	1	11	0	57	0	44
2	1	46	1	28	1	12	0	58	0	45
3	1	48	1	30	1	14	0	59	0	46
4	1	49	1	31	1	15	1	0	0	46
5	1	51	1	33	1	16	1	1	0	47
6	1	53	1	34	1	17	1	1	0	48
7	1	54	1	35	1	18	1	2	0	48
8	1	56	1	36	1	19	1	3	0	49
9	1	57	1	37	1	20	1	4	0	49
10	1	58	1	38	1	20	1	4	0	50
11	1	59	1	39	1	21	1	5	0	50
12	2	0	1	40	1	22	1	5	0	51
13	2	0	1	40	1	22	1	5	0	51
14	2	1	1	41	1	22	1	6	0	51
15	2	1	1	41	1	23	1	6	0	51
16	2	2	1	41	1	23	1	6	0	51
17	2	2	1	41	1	23	1	6	0	51
18	2	2	1	42	1	23	1	6	0	51
19	2	2	1	41	1	23	1	6	0	51
20	2	2	1	41	1	23	1	6	0	51
21	2	1	1	41	1	22	1	5	0	50
22	2	1	1	40	1	22	1	5	0	50
23	2	0	1	40	1	21	1	4	0	50
24	1	59	1	39	1	21	1	4	0	50
25	1	58	1	38	1	20	1	3	0	49
26	1	57	1	37	1	19	1	3	0	49
27	1	56	1	36	1	19	1	2	0	48
28	1	55	1	35	1	18	1	1	0	48
29	1	54	1	34	1	17	1	1	0	47
30	1	52	1	33	1	15	1	0	0	46

EQUATION *to be applied to* Half Mean Anomaly ☽.

MEAN ANOMALY.

Signs 2. A D D.

Log.	9.942		9.947		9.952		9.957		9.962	
°	′	″	′	″	′	″	′	″	′	″
0	1	52	1	33	1	15	1	0	0	46
1	1	51	1	31	1	14	0	59	0	46
2	1	49	1	30	1	13	0	58	0	45
3	1	47	1	28	1	11	0	57	0	44
4	1	45	1	26	1	10	0	56	0	43
5	1	43	1	25	1	8	0	54	0	42
6	1	40	1	23	1	7	0	53	0	41
7	1	38	1	21	1	5	0	52	0	40
8	1	36	1	19	1	4	0	50	0	39
9	1	33	1	17	1	2	0	49	0	38
10	1	30	1	14	1	0	0	47	0	36
11	1	28	1	12	0	58	0	46	0	35
12	1	25	1	9	0	56	0	44	0	34
13	1	22	1	7	0	54	0	42	0	32
14	1	19	1	4	0	52	0	41	0	31
15	1	16	1	2	0	50	0	39	0	30
16	1	12	0	59	0	47	0	37	0	28
17	1	9	0	56	0	45	0	35	0	27
18	1	5	0	53	0	43	0	33	0	25
19	1	2	0	50	0	40	0	31	0	24
20	0	58	0	47	0	38	0	29	0	22
21	0	55	0	44	0	35	0	27	0	20
22	0	51	0	41	0	33	0	25	0	19
23	0	47	0	38	0	30	0	23	0	17
24	0	44	0	35	0	28	0	21	0	16
25	0	40	0	32	0	25	0	19	0	14
26	0	36	0	28	0	22	0	17	0	12
27	0	32	0	25	0	20	0	15	0	11
28	0	28	0	22	0	17	0	12	0	9
29	0	24	0	19	0	14	0	10	0	7
30	0	20	0	15	0	11	0	8	0	6

EQUATION *to be applied to* Half Mean Anomaly ☽.

MEAN ANOMALY.

Signs 3. ADD.

Log.	9.942		9.947		9.952		9.957		9.962	
°	′	″	′	″	′	″	′	″	′	″
0	0	20	0	15	0	11	0	8	0	6
1	0	16	0	12	0	9	0	6	0	4
2	0	12	0	9	0	6	0	4	0	2
3	0	8	0	5	0	3	0	2	0	1
4	0	4	0	2	0	0	Sub.	0	Sub.	1
5	Sub.		Sub.	1	Sub.	2	0	2	0	3
6	0	4	0	4	0	5	0	5	0	4
7	0	8	0	8	0	7	0	7	0	6
8	0	12	0	11	0	10	0	9	0	8
9	0	16	0	14	0	13	0	11	0	10
10	0	20	0	18	0	16	0	13	0	11
11	0	24	0	21	0	18	0	16	0	13
12	0	27	0	24	0	21	0	18	0	14
13	0	31	0	27	0	24	0	20	0	16
14	0	35	0	31	0	26	0	22	0	18
15	0	39	0	34	0	29	0	24	0	19
16	0	43	0	37	0	31	0	26	0	21
17	0	46	0	40	0	34	0	28	0	22
18	0	50	0	43	0	36	0	30	0	24
19	0	53	0	46	0	38	0	32	0	25
20	0	57	0	48	0	41	0	33	0	27
21	1	0	0	51	0	43	0	35	0	28
22	1	3	0	54	0	45	0	37	0	29
23	1	6	0	56	0	47	0	39	0	31
24	1	9	0	59	0	49	0	40	0	32
25	1	12	1	1	0	51	0	42	0	33
26	1	15	1	4	0	53	0	43	0	34
27	1	18	1	6	0	55	0	45	0	36
28	1	21	1	9	0	57	0	46	0	37
29	1	23	1	11	0	59	0	48	0	38
30	1	26	1	13	1	0	0	49	0	39

EQUATION *to be applied to* Half Mean Anomaly ☽.

MEAN ANOMALY.

Signs 4. SUBTRACT.

Log.	9·942		9·947		9·952		9·957		9·962	
°	′	″	′	″	′	″	′	″	′	″
0	1	26	1	13	1	0	0	49	0	39
1	1	29	1	15	1	2	0	50	0	40
2	1	30	1	16	1	3	0	51	0	41
3	1	32	1	18	1	5	0	52	0	42
4	1	34	1	20	1	6	0	53	0	42
5	1	36	1	21	1	7	0	54	0	43
6	1	38	1	23	1	8	0	55	0	44
7	1	39	1	24	1	9	0	56	0	44
8	1	41	1	25	1	10	0	57	0	45
9	1	42	1	26	1	11	0	57	0	45
10	1	44	1	27	1	12	0	58	0	46
11	1	45	1	28	1	13	0	58	0	46
12	1	45	1	29	1	13	0	59	0	46
13	1	46	1	29	1	13	0	59	0	46
14	1	47	1	30	1	14	1	0	0	47
15	1	47	1	30	1	14	1	0	0	47
16	1	47	1	30	1	14	1	0	0	47
17	1	48	1	30	1	15	1	0	0	47
18	1	48	1	30	1	15	1	0	0	47
19	1	48	1	30	1	15	1	0	0	47
20	1	47	1	30	1	14	1	0	0	47
21	1	47	1	30	1	14	0	59	0	47
22	1	46	1	29	1	13	0	59	0	46
23	1	45	1	29	1	13	0	58	0	46
24	1	44	1	28	1	12	0	58	0	45
25	1	43	1	27	1	12	0	57	0	45
26	1	42	1	26	1	11	0	57	0	44
27	1	41	1	25	1	10	0	56	0	44
28	1	40	1	24	1	9	0	55	0	43
29	1	38	1	22	1	8	0	54	0	43
30	1	36	1	21	1	6	0	53	0	42

EQUATION *to be applied to* Half Mean Anomaly ☽.

MEAN ANOMALY.

Signs 5. SUBTRACT.

Log.	9.942		9.947		9.952		9.957		9.962	
°	′	″	′	″	′	″	′	″	′	″
0	1	36	1	21	1	6	0	53	0	42
1	1	35	1	19	1	5	0	52	0	41
2	1	33	1	18	1	4	0	51	0	40
3	1	31	1	16	1	2	0	50	0	39
4	1	28	1	14	1	1	0	49	0	38
5	1	26	1	12	0	59	0	47	0	37
6	1	24	1	10	0	57	0	46	0	36
7	1	21	1	8	0	56	0	44	0	35
8	1	18	1	6	0	54	0	43	0	34
9	1	16	1	3	0	52	0	41	0	33
10	1	13	1	1	0	50	0	40	0	31
11	1	10	0	58	0	48	0	38	0	30
12	1	7	0	56	0	46	0	37	0	29
13	1	3	0	53	0	43	0	35	0	27
14	1	0	0	50	0	41	0	33	0	26
15	0	57	0	48	0	39	0	31	0	24
16	0	53	0	45	0	37	0	29	0	23
17	0	50	0	42	0	34	0	27	0	21
18	0	46	0	39	0	32	0	25	0	20
19	0	43	0	36	0	29	0	23	0	18
20	0	39	0	33	0	27	0	21	0	17
21	0	35	0	29	0	24	0	19	0	15
22	0	31	0	26	0	21	0	17	0	13
23	0	28	0	23	0	19	0	15	0	12
24	0	24	0	20	0	16	0	13	0	10
25	0	20	0	16	0	13	0	11	0	8
26	0	16	0	13	0	11	0	9	0	7
27	0	12	0	10	0	8	0	7	0	5
28	0	8	0	7	0	5	0	4	0	3
29	0	4	0	3	0	3	0	2	0	2
30	0	0	0	0	0	0	0	0	0	0

TABLE *of the Variation of the* MOON. (*According to Sir* ISAAC NEWTON.)

ADD.

☽ - ☉	0 Si. 6		Increment.	1 Si. 7		Increment.	2 Si. 8		Increment.	☽ - ☉
°	'	"	"	'	"	"	'	"	"	°
0	0	0	0	28	43	208	28	43	208	30
1	1	9	8	29	17	212	28	8	203	29
2	2	18	17	29	48	216	27	30	198	28
3	3	28	25	30	17	219	26	50	194	27
4	4	37	33	30	46	223	26	8	189	26
5	5	45	42	31	10	226	25	25	184	25
6	6	54	50	31	33	228	24	38	178	24
7	8	1	58	31	51	231	23	51	173	23
8	9	8	66	32	11	233	23	2	167	22
9	10	15	74	32	27	235	22	11	161	21
10	11	21	82	32	40	236	21	19	154	20
11	12	25	90	32	51	238	20	26	148	19
12	13	29	98	32	59	239	19	29	141	18
13	14	32	105	33	6	239	18	32	134	17
14	15	34	113	33	10	240	17	35	127	16
15	16	36	120	33	12	240	16	35	120	15
16	17	35	127	33	10	240	15	34	113	14
17	18	32	134	33	6	239	14	32	105	13
18	19	29	141	32	59	239	13	29	98	12
19	20	26	148	32	51	238	12	25	90	11
20	21	19	154	32	40	236	11	21	82	10
21	22	11	161	32	27	235	10	15	74	9
22	23	2	167	32	11	233	9	8	66	8
23	23	51	173	31	51	231	8	1	58	7
24	24	38	178	31	33	228	6	54	50	6
25	25	25	184	31	10	226	5	45	42	5
26	26	8	189	30	46	223	4	37	33	4
27	26	50	194	30	17	219	3	28	25	3
28	27	30	198	29	48	216	2	18	17	2
29	28	8	203	29	17	212	1	9	8	1
30	28	43	208	28	43	208	0	0	0	0
	11 Si. 5		Increment.	10 Si. 4		Increment.	9 Si. 3		Increment.	

SUBTRACT.

TABLE of the Variation of the Moon.
(According to Mr. Machin.)

☉ − ☽	ADD.									☉ − ☽
Signs	0	6	Increment.	1	7	Increment.	2	8	Increment.	Signs
°	′	″	″	′	″	″	′	″	″	°
0	0	0	0	27	43	208	27	43	208	30
1	1	7	8	28	15	212	27	8	203	29
2	2	14	17	28	46	216	26	32	198	28
3	3	21	25	29	14	219	25	53	194	27
4	4	27	33	29	40	223	25	13	189	26
5	5	33	42	30	4	226	24	31	184	25
6	6	39	50	30	26	228	23	47	178	24
7	7	45	58	30	46	231	23	1	173	23
8	8	49	66	31	2	233	22	14	167	22
9	9	53	74	31	18	235	21	25	161	21
10	10	57	82	31	31	236	20	34	154	20
11	11	59	90	31	41	238	19	42	148	19
12	13	1	98	31	49	239	18	49	141	18
13	14	2	105	31	55	239	17	54	134	17
14	15	1	113	31	59	240	16	58	127	16
15	16	0	120	32	0	240	16	0	120	15
16	16	58	127	31	59	240	15	1	113	14
17	17	54	134	31	55	239	14	2	105	13
18	18	49	141	31	49	239	13	1	98	12
19	19	42	148	31	41	238	11	59	90	11
20	20	34	154	31	31	236	10	57	82	10
21	21	25	161	31	18	235	9	53	74	9
22	22	14	167	31	3	233	8	49	66	8
23	23	1	173	30	46	231	7	45	58	7
24	23	47	178	30	26	228	6	39	50	6
25	24	31	184	30	4	226	5	33	42	5
26	25	13	189	29	40	223	4	27	33	4
27	25	53	194	29	14	219	3	21	25	3
28	26	32	198	28	46	216	2	14	17	2
29	27	8	203	28	15	212	1	7	8	1
30	27	43	208	27	43	208	0	0	0	0
Signs	11	5	Increment.	10	4	Increment	9	3	Increment.	Signs
	SUBTRACT.									

☉ Mean Anomaly.	DECIMAL MULTIPLIERS *to the* Increments *in the* Variation Tables.						☉ Mean Anomaly.
Sign	0	1	2	3	4	5	Sign
°							°
0	.0000	.065	.25	.5	.751	.935	30
1	.0006	.07	.257	.507	.76	.939	29
2	.0013	.074	.264	.516	.766	.943	28
3	.0019	.079	.272	.525	.774	.946	27
4	.0025	.083	.28	.534	.782	.95	26
5	.0022	.088	.287	.543	.79	.954	25
6	.0038	.092	.295	.552	.797	.958	24
7	.0051	.098	.303	.561	.804	.961	23
8	.0064	.104	.312	.57	.81	.964	22
9	.0077	.109	.32	.578	.816	.968	21
10	.009	.115	.33	.587	.823	.971	20
11	.01	.121	.337	.596	.83	.974	19
12	.012	.126	.345	.605	.835	.977	18
13	.013	.133	.353	.614	.842	.981	17
14	.014	.14	.362	.622	.848	.985	16
15	.015	.146	.37	.63	.855	.989	15
16	.017	.152	.38	.64	.861	.993	14
17	.018	.158	.386	.647	.867	.996	13
18	.019	.165	.395	.655	.874	1.—	12
19	.023	.171	.404	.664	.88	1.—	11
20	.027	.177	.413	.672	.885	1.—	10
21	.031	.183	.422	.68	.891	1.—	9
22	.035	.19	.43	.688	.897	1.—	8
23	.038	.195	.44	.697	.902	1.—	7
24	.042	.201	.45	.705	.908	1.—	6
25	.046	.21	.457	.713	.913	1.—	5
26	.05	.217	.465	.720	.917	1.—	4
27	.054	.225	.473	.728	.922	1.—	3
28	.057	.23	.482	.736	.926	1.—	2
29	.061	.241	.49	.743	.931	1.—	1
30	.065	.25	.5	.751	.935	1.—	0
Sign	11	10	9	8	7	6	Sign

☊ − ☉	Seventh Equation *of the* Moon.			☊ − ☉
Sign.	0 S.	1 S.	2 S.	Sign
Sign.	6 A.	7 A.	8 A.	Sign.
°	′ ″	′ ″	′ ″	°
0	0 0	1 10	2 1	30
1	0 2	1 12	2 2	29
2	0 5	1 14	2 4	28
3	0 7	1 16	2 5	27
4	0 10	1 18	2 6	26
5	0 12	1 20	2 7	25
6	0 15	1 22	2 8	24
7	0 17	1 24	2 9	23
8	0 19	1 26	2 10	22
9	0 22	1 28	2 11	21
10	0 24	1 30	2 12	20
11	0 27	1 32	2 12	19
12	0 29	1 34	2 13	18
13	0 32	1 35	2 14	17
14	0 34	1 37	2 15	16
15	0 36	1 39	2 15	15
16	0 39	1 41	2 16	14
17	0 41	1 42	2 16	13
18	0 43	1 44	2 17	12
19	0 46	1 46	2 17	11
20	0 48	1 47	2 18	10
21	0 50	1 49	2 18	9
22	0 52	1 50	2 19	8
23	0 55	1 52	2 19	7
24	0 57	1 53	2 19	6
25	0 59	1 55	2 19	5
26	1 1	1 56	2 20	4
27	1 4	1 57	2 20	3
28	1 6	1 59	2 20	2
29	1 8	2 0	2 20	1
30	1 10	2 1	2 20	0
Sign.	5 S.	4 S.	3 S.	Sign.
Sign.	11 A.	10 A.	9 A.	Sign.

☽ Node à ☉.	Second Equ. Node *and* Inclination *of the* Limit *above the least*, viz. 4° 59′ 35″															☽ Node à ☉.
	ADD.															
Sign.	0	6		Incli. Limit		1	7		Incli. Limit		2	8		Incli. Limit		Sign.
°	°	′	″	′	″	°	′	″	′	″	°	′	″	′	″	°
0	0	0	0	17	45	1	16	41	13	22	1	18	44	4	27	30
1	0	3	3	17	45	1	18	16	13	6	1	17	13	4	11	29
2	0	6	6	17	44	1	19	44	12	49	1	15	29	3	55	28
3	0	9	8	17	44	1	21	6	12	32	1	13	43	3	40	27
4	0	12	10	17	42	1	22	23	12	15	1	11	53	3	25	26
5	0	15	12	17	40	1	23	34	11	58	1	9	55	3	11	25
6	0	18	12	17	37	1	24	39	11	41	1	7	52	2	57	24
7	0	21	10	17	33	1	25	38	11	24	1	5	44	2	43	23
8	0	24	8	17	28	1	26	31	11	7	1	3	32	2	29	22
9	0	27	4	17	22	1	27	17	10	49	1	1	14	2	16	21
10	0	29	57	17	15	1	27	58	10	31	0	58	51	2	4	20
11	0	32	49	17	8	1	28	32	10	13	0	56	24	1	53	19
12	0	35	39	17	0	1	28	59	9	55	0	53	53	1	42	18
13	0	38	26	16	52	1	29	21	9	37	0	51	17	1	31	17
14	0	41	10	16	44	1	29	35	9	18	0	48	38	1	21	16
15	0	43	53	16	35	1	29	43	8	59	0	45	54	1	11	15
16	0	46	30	16	26	1	29	45	8	40	0	43	7	1	2	14
17	0	49	7	16	17	1	29	40	8	20	0	40	16	0	53	13
18	0	51	39	16	7	1	29	28	8	0	0	37	24	0	45	12
19	0	54	8	15	56	1	29	10	7	40	0	34	26	0	38	11
20	0	56	33	15	44	1	28	46	7	21	0	31	27	0	32	10
21	0	58	54	15	32	1	28	14	7	2	0	28	25	0	26	9
22	1	1	11	15	19	1	27	37	6	44	0	25	22	0	21	8
23	1	3	24	15	6	1	26	52	6	26	0	22	16	0	16	7
24	1	5	32	14	52	1	26	1	6	8	0	19	8	0	12	6
25	1	7	36	14	38	1	25	4	5	50	0	15	59	0	8	5
26	1	9	35	14	24	1	24	1	5	33	0	12	49	0	5	4
27	1	11	30	14	9	1	22	51	5	16	0	9	38	0	3	3
28	1	13	19	13	54	1	21	35	4	59	0	6	26	0	1	2
29	1	15	2	13	38	1	20	12	4	43	0	3	13	0	0	1
30	1	16	41	13	22	1	18	44	4	27	0	0	0	0	0	0
Sign.	11	5				10	4				9	3				Sign.

SUBTRACT.

Reduction *with the* **Excess** *above the least* **Inclination, 4° 59′ 35″.**

SUBTRACT.

☽ Node / ☽ in Orb.										☽ Node / ☽ in Orb.
Sign.	0	6	Exc.	1	7	Exc.	2	8	Exc.	Sign.
°	′	″	″	′	″	″	′	″	″	°
0	0	0	0	5	40	42	5	40	42	30
1	0	14	2	5	47	43	5	33	41	29
2	0	27	4	5	53	44	5	25	40	28
3	0	41	6	5	59	45	5	17	39	27
4	0	55	8	6	4	46	5	10	38	26
5	1	8	9	6	8	46	5	1	37	25
6	1	22	11	6	13	46	4	52	36	24
7	1	35	12	6	17	47	4	42	35	23
8	1	48	13	6	20	47	4	33	34	22
9	2	1	15	6	23	47	4	23	33	21
10	2	14	17	6	26	47	4	13	31	20
11	2	27	19	6	28	47	4	2	30	19
12	2	40	20	6	30	48	3	51	29	18
13	2	52	22	6	31	48	3	40	28	17
14	3	4	23	6	32	48	3	29	26	16
15	3	16	24	6	32	48	3	17	24	15
16	3	28	26	6	32	48	3	5	23	14
17	3	40	28	6	31	48	2	53	22	13
18	3	51	29	6	30	48	2	40	20	12
19	4	2	30	6	29	47	2	28	19	11
20	4	12	31	6	26	47	2	15	17	10
21	4	23	33	6	23	47	2	2	15	9
22	4	33	34	6	20	47	1	49	13	8
23	4	44	35	6	17	47	1	35	12	7
24	4	52	36	6	12	46	1	22	11	6
25	5	1	37	6	8	46	1	8	9	5
26	5	9	38	6	3	46	0	55	8	4
27	5	18	39	5	58	45	0	41	6	3
28	5	26	40	5	52	44	0	27	4	2
29	5	33	41	5	46	43	0	14	2	1
30	5	40	42	5	40	42	0	0	0	0
Sign.	11	5		10	7		9	3		Sign.

ADD.

The Simple Latitude *of the* Moon *with the* Increment *to the* greateſt Inclination.

☽ Node à ☽ Orb. Sign.	0 N. 6 S. } Aſc. °	′	″	Incre-ment. ′	″	1 N. 7 S. } Aſc. °	′	″	Incre ment ′	″	2 N. 8 S. } Aſc. °	′	″	Incre-ment. ′	″	☽ Node à ☽ Orb. Sign.
0	0	0	0	0	0	2	29	39	8	50	4	19	22	15	21	30
1	0	5	14	0	19	2	34	9	9	7	4	21	58	15	30	29
2	0	10	27	0	37	2	38	37	9	21	4	24	56	15	39	28
3	0	15	40	0	56	2	43	1	9	39	4	26	52	15	47	27
4	0	20	52	1	14	2	47	22	9	54	4	29	12	15	56	26
5	0	26	4	1	32	2	51	41	10	9	4	31	27	16	4	25
6	0	31	17	1	50	2	55	56	10	25	4	33	37	16	12	24
7	0	36	28	2	9	3	0	8	10	39	4	35	43	16	19	23
8	0	41	38	2	28	3	4	18	10	54	4	37	43	16	27	22
9	0	46	48	2	46	3	8	23	11	8	4	39	38	16	34	21
10	0	51	57	3	5	3	12	25	11	21	4	41	28	16	40	20
11	0	57	5	3	23	3	16	24	11	37	4	43	13	16	46	19
12	1	2	13	3	40	3	20	19	11	51	4	44	53	16	52	18
13	1	7	18	3	58	3	24	11	12	4	4	46	27	16	57	17
14	1	12	23	4	16	3	27	58	12	19	4	47	57	17	3	16
15	1	17	27	4	34	3	31	42	12	31	4	49	21	17	8	15
16	1	22	29	4	52	3	35	22	12	45	4	50	39	17	13	14
17	1	27	29	5	11	3	38	58	12	58	4	51	53	17	18	13
18	1	32	28	5	28	3	42	30	13	8	4	53	1	17	22	12
19	1	37	26	5	46	3	45	5	13	21	4	54	4	17	25	11
20	1	42	21	5	4	3	49	22	13	33	4	55	1	17	29	10
21	1	47	14	6	19	3	52	42	13	47	4	55	53	17	32	9
22	1	52	6	6	38	3	55	58	13	58	4	56	39	17	35	8
23	1	56	56	6	56	3	59	9	14	8	4	57	20	17	37	7
24	2	1	43	7	10	4	2	16	14	19	4	57	56	17	39	6
25	2	6	28	7	27	4	5	18	14	30	4	58	26	17	41	5
26	2	11	11	7	44	4	8	16	14	41	4	58	21	17	43	4
27	2	15	52	8	4	4	11	9	14	54	4	59	10	17	44	3
28	2	20	30	8	19	4	13	58	15	2	4	59	24	17	44	2
29	2	25	7	8	35	4	16	42	15	11	4	59	32	17	45	1
30	2	29	39	8	50	4	19	22	15	21	4	59	35	17	45	0
Sign.	5 N. 11 S. } De.					4 N. 10 S. } De.					3 N. 9 S. } De.					Sign.

☽ *Apo.* à ☉ 1° *Ti. equ.*	Eccentricities *of the* Moon.			☽ *Apo.* à ☉ 1° *Ti. equ.*
	0 Signs 6	Signs 7	2 Signs 8	
0	66777	61754	50224	30
1	66771	61434	49838	29
2	66754	61107	49457	28
3	66724	60772	49082	27
4	66683	60429	48714	26
5	66630	60080	48354	25
6	66566	59725	48001	24
7	66489	59363	47656	23
8	66402	58995	47321	22
9	66302	58621	46995	21
10	66192	58243	46679	20
11	66070	57860	46374	19
12	65936	57472	46081	18
13	65792	57080	45800	17
14	65636	56684	45531	16
15	65469	56285	45275	15
16	65292	55884	45033	14
17	65103	55479	44805	13
18	64905	55073	44592	12
19	64695	54666	44394	11
20	64476	54257	44212	10
21	64246	53848	44046	9
22	64006	53438	43896	8
23	63757	53030	43763	7
24	63498	52622	43647	6
25	63230	52215	43548	5
26	62952	51811	43467	4
27	62665	51409	43404	3
28	62370	51010	43359	2
29	62066	50615	43332	1
30	61754	50224	43323	0
	11 Signs 5	10 Signs 4	9 Signs 3	

TABLE *of the true* Horary Motion *and* Semidiameter *of the* Sun's Horizontal Parallax *of* ☽ *at* greatest *and* least Eccentricity.

Mean Anom. ⊙ & ☽		⊙ true Horary Motion.		Apparent Semidia. ⊙		Least Ecc. 43323 ☽ H. Par.		Great Ex. 66777 ☽ H. Par.		Mean Anom. ⊙ & ☽	
s	°	′	″	′	″	′	″	′	″	s	°
0	0	2	23	15	49	55	7	53	54	12	0
	6	2	23	15	49	55	8	53	55		24
	12	2	23	15	49	55	10	53	57		18
	18	2	23	15	50	55	14	54	3		12
	24	2	23	15	50	55	18	54	10		6
1	0	2	24	15	51	55	24	54	18	11	0
	6	2	24	15	51	55	31	54	29		24
	12	2	24	15	52	55	40	54	41		18
	18	2	24	15	53	55	50	54	57		12
	24	2	25	15	55	56	1	55	11		6
2	0	2	25	15	56	56	13	55	28	10	0
	6	2	26	15	57	56	26	55	47		24
	12	2	26	15	59	56	39	56	7		18
	18	2	27	16	1	56	54	56	29		12
	24	2	27	16	3	57	8	56	52		6
3	0	2	28	16	5	57	24	57	15	9	0
	6	2	28	16	6	57	39	57	39		24
	12	2	29	16	7	57	55	58	3		18
	18	2	29	16	10	58	11	58	28		12
	24	2	30	16	11	58	27	58	53		6
4	0	2	30	16	13	58	42	59	17	8	0
	6	2	31	16	14	58	56	59	40		24
	12	2	31	16	15	59	10	60	1		18
	18	2	32	16	16	59	22	60	22		12
	24	2	32	16	18	59	33	60	41		6
5	0	2	32	16	19	59	4[illegible]	60	57	7	0
	6	2	33	16	20	59	52	61	11		24
	12	2	33	16	20	59	58	61	23		18
	18	2	33	16	21	60	2	61	31		12
	24	2	33	16	22	60	5	61	35		6
6	0	2	33	16	22	60	6	61	36	6	0

DECIMAL MULTIPLICATORS *for the* Proſthaphereſes *to* ☽'*s* Horizontal Parallaxes *out of the* Syzygys.

Sign.	0 6	1 7	2 8	Sign.
0	.000	.435	.765	30
1	.015	.447	.771	29
2	.029	.458	.777	28
3	.044	.467	.783	27
4	.058	.481	.788	26
5	.073	.493	.794	25
6	.087	.505	.8	24
7	.102	.516	.806	23
8	.116	.528	.812	22
9	.131	.54	.817	21
10	.145	.551	.823	20
11	.16	.563	.83	19
12	.174	.574	.835	18
13	.192	.586	.838	17
14	.201	.597	.841	16
15	.226	.61	.844	15
16	.244	.62	.847	14
17	.261	.632	.85	13
18	.28	.644	.852	12
19	.29	.655	.855	11
20	.3	.67	.858	10
21	.313	.678	.861	9
22	.325	.69	.864	8
23	.336	.702	.867	7
24	.348	.714	.87	6
25	.363	.722	.87	5
26	.377	.731	.87	4
27	.391	.74	.87	3
28	.406	.748	.87	2
29	.42	.757	.87	1
30	.435	.765	.87	0
Sign.	5 11	4 10	3 9	Sign.

Alt. ☉ or ☽.	Paralx. ☉	Diameter ☽ Apog. Add.	Diameter ☽ Perig. Add.
″	″	″	″
0	12	0	0
3	12	2	2
6	12	3	4
9	12	5	6
12	12	6	7
15	12	8	9
18	12	9	11
21	12	10	12
24	11	11	15
27	11	12	16
30	11	14	18
33	10	15	19
36	10	16	21
39	10	18	23
42	9	19	24
45	9	20	25
48	8	21	27
51	8	22	28
54	7	23	29
57	7	23	30
60	6	24	31
63	6	25	32
66	5	26	33
69	4	26	34
72	4	27	34
75	3	27	35
78	3	27	35
81	2	28	36
84	1	28	36
87	1	28	36
90	0	29	36

Reduction *of* Time *from the* Conjunction *and* Opposition *of the* ☽ *in her* Orbit *to the* Middle *of the* Eclipse.

☽ ☊ *à* ☽ *in her* Orbit.

o Signs 6.

S U B T R A C T.

True Horary Motion *of the* Moon *à* ☉.

	27′		28′		29′		30′		31′		32′		33′		34′		35′		36′		
°	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	°
0	0	00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
1	0	36	0	35	0	34	0	32	0	31	0	30	0	29	0	28	0	27	0	26	29
2	1	13	1	11	1	8	1	6	1	3	1	2	1	0	0	57	0	55	0	53	28
3	1	50	1	47	1	43	1	39	1	35	1	33	1	30	1	26	1	23	1	21	27
4	2	27	2	22	2	17	2	12	2	7	2	3	1	59	1	54	1	51	1	48	26
5	3	4	2	58	2	51	2	45	2	39	2	33	2	29	2	23	2	19	2	15	25
6	3	40	3	33	3	24	3	17	3	10	3	3	2	58	2	51	2	47	2	41	24
7	4	16	4	7	3	58	3	49	3	41	3	33	3	27	3	20	3	15	3	8	23
8	4	52	4	41	4	30	4	21	4	12	4	3	3	55	3	48	3	41	3	35	22
9	5	27	5	14	5	2	4	52	4	42	4	32	4	23	4	15	4	8	4	2	21
10	6	1	5	47	5	33	5	22	5	11	5	0	4	50	4	42	4	33	4	28	20
11	6	34	6	19	6	4	5	51	5	39	5	27	5	16	5	7	4	59	4	52	19
12	7	5	6	49	6	34	6	19	6	6	5	53	5	42	5	32	5	23	5	16	18
13	7	36	7	19	7	3	6	47	6	33	6	19	6	7	5	56	5	46	5	39	17
14	8	7	7	48	7	31	7	14	6	59	6	44	6	31	6	19	6	9	6	1	16
15	8	36	8	16	7	58	7	41	7	25	7	10	6	56	6	42	6	31	6	23	15

A D D.

11 Signs 5.

☽ ☊ *à* ☽ *in her* Orbit.

Angle *of the* Visible Way *of the* Moon *with the* Ecliptic *in* Eclipses.

☽ ☊ *à* ☽ *in her* Orbit.

o Signs 6.

True Horary Motion *of the* Moon *à* ☉.

	27′		28′		29′		30′		31′		32′		33′		34′		35′		36′		
°	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°
0	5	47	5	46	5	45	5	44	5	43	5	42	5	41	5	41	5	40	5	39	30
1	5	47	5	46	5	45	5	44	5	43	5	42	5	41	5	41	5	40	5	39	29
2	5	47	5	45	5	44	5	43	5	43	5	42	5	41	5	40	5	40	5	39	28
3	5	46	5	45	5	44	5	43	5	42	5	42	5	41	5	40	5	40	5	39	27
4	5	46	5	45	5	44	5	43	5	42	5	41	5	41	5	40	5	39	5	39	26
5	5	45	5	44	5	43	5	42	5	42	5	41	5	40	5	39	5	39	5	38	25
6	5	45	5	44	5	43	5	42	5	41	5	40	5	39	5	39	5	38	5	38	24
7	5	44	5	43	5	42	5	41	5	40	5	40	5	39	5	38	5	38	5	37	23
8	5	43	5	42	5	41	5	40	5	40	5	39	5	38	5	37	5	37	5	36	22
9	5	42	5	41	5	40	5	39	5	39	5	38	5	37	5	37	5	36	5	35	21
10	5	41	5	4[illegible]	5	39	5	38	5	38	5	37	5	36	5	36	5	35	5	34	20
11	5	40	5	39	5	38	5	37	5	37	5	36	5	35	5	35	5	34	5	33	19
12	5	39	5	38	5	37	5	36	5	35	5	35	5	34	5	33	5	33	5	32	18
13	5	38	5	37	5	36	5	35	5	34	5	33	5	33	5	32	5	31	5	31	17
14	5	36	5	35	5	34	5	34	5	33	5	32	5	31	5	31	5	30	5	29	16
15	5	35	5	34	5	33	5	32	5	31	5	31	5	30	5	29	5	29	5	28	15

11 Signs 5.

☽ ☊ *à* ☽ *in her* Orbit.

TABLE *of the* Declination *to* each Degree *of the* ECLIPTIC.

Signs	0		6	1		7	2		8	Signs
°	°	′	″	°	′	″	°	′	″	°
0	0	0	0	11	29	33	20	11	16	30
1	0	23	54	11	50	35	20	23	49	29
2	0	47	48	12	11	26	20	36	6	28
3	1	11	42	12	32	5	20	47	48	27
4	1	35	34	12	52	31	20	59	13	26
5	1	59	25	13	12	44	21	10	15	25
6	2	23	14	13	32	45	21	20	53	24
7	2	47	1	13	52	32	21	31	7	23
8	3	10	45	14	12	05	21	40	58	22
9	3	34	26	14	31	24	21	50	24	21
10	3	58	4	15	50	28	21	59	25	20
11	4	21	38	15	9	17	22	8	2	19
12	4	45	8	15	27	51	22	16	14	18
13	5	8	34	15	46	9	22	24	0	17
14	5	31	55	16	4	11	22	31	21	16
15	5	55	11	16	21	57	22	38	16	15
16	6	18	21	16	39	26	22	44	45	14
17	6	41	25	16	56	37	22	50	49	13
18	7	4	23	17	13	31	22	56	26	12
19	7	27	15	17	30	7	23	1	36	11
20	7	50	0	17	46	25	23	6	20	10
21	8	12	36	18	2	24	23	10	38	9
22	8	35	5	18	18	3	23	14	29	8
23	8	57	26	18	33	24	23	17	52	7
24	9	19	39	18	48	25	23	20	49	6
25	9	41	43	19	3	5	23	23	19	5
26	10	3	37	19	17	26	23	25	22	4
27	10	25	21	19	31	25	23	26	57	3
28	10	46	56	19	45	3	23	28	5	2
29	10	8	20	19	58	20	23	28	46	1
30	10	29	33	20	11	16	23	29	0	0
Signs	11		5	10		4	9		3	Signs

TABLE *of the* Right Aſcenſion *to* each Degree *of the* ECLIPTIC.

Signs	0			1			2			Signs
°	°	′	″	°	′	″	°	′	″	°
0	0	0	0	27	54	9	57	48	36	0
1	0	55	2	28	51	32	58	51	9	1
2	1	50	4	29	49	3	59	53	52	2
3	2	45	7	30	46	44	60	56	46	3
4	3	40	10	31	44	33	61	59	49	4
5	4	35	15	32	42	32	63	3	1	5
6	5	30	22	33	40	41	64	6	23	6
7	6	25	31	34	38	59	65	9	54	7
8	7	20	42	35	37	28	66	13	33	8
9	8	15	55	36	36	6	67	17	21	9
10	9	11	11	37	34	55	68	21	18	10
11	10	6	30	38	33	54	69	25	22	11
12	11	1	53	39	33	3	70	29	33	12
13	11	57	20	40	32	22	71	33	53	13
14	12	52	51	41	31	53	72	38	19	14
15	13	48	26	42	31	34	73	42	52	15
16	14	44	6	43	31	26	74	47	31	16
17	15	39	51	44	31	29	75	52	16	17
18	16	35	40	45	31	43	76	57	7	18
19	17	31	35	46	32	7	78	2	3	19
20	18	27	36	47	32	43	79	7	3	20
21	19	23	44	48	33	30	80	12	8	21
22	20	19	58	49	34	28	81	17	17	22
23	21	16	18	50	35	36	82	22	30	23
24	22	12	46	51	36	55	83	27	45	24
25	23	9	20	52	38	25	84	33	4	25
26	24	6	2	53	40	6	85	38	24	26
27	25	2	52	54	41	58	86	43	46	27
28	25	59	49	55	44	0	87	49	10	28
29	26	56	55	56	46	13	88	54	35	29
30	27	64	9	57	48	36	90	0	0	30

When the Signs exceed 6 Subtract 6 therefrom, and to the Right Aſcenſion of the Remainder add 180 Deg.

TABLE *of the* Right Aſcenſion *to* each Degree *of the* Ecliptic.

Signs	3			4			5			Signs
°	°	′	″	°	′	″	°	′	″	°
0	90	0	0	122	11	24	152	5	51	0
1	91	5	25	123	13	47	153	3	5	1
2	92	10	50	124	16	0	154	0	11	2
3	93	16	14	125	18	2	154	57	8	3
4	94	21	36	126	19	54	155	53	58	4
5	95	26	56	127	21	35	156	50	40	5
6	96	32	15	128	23	5	157	47	14	6
7	97	37	30	129	24	24	158	43	42	7
8	98	42	43	130	25	32	159	40	2	8
9	99	47	52	131	26	30	160	36	16	9
10	100	52	57	132	27	17	161	32	24	10
11	101	57	57	133	27	53	162	28	25	11
12	103	2	53	134	28	17	163	24	20	12
13	104	7	44	135	28	31	164	20	9	13
14	105	12	29	136	28	34	165	15	54	14
15	106	17	28	137	28	25	166	11	34	15
16	107	21	21	138	28	7	167	7	9	16
17	108	26	7	139	27	38	168	2	40	17
18	109	30	27	140	26	57	168	58	7	18
19	110	34	38	141	26	6	169	53	30	19
20	111	38	42	142	25	5	170	48	49	20
21	112	42	39	143	23	54	171	44	5	21
22	113	46	27	144	22	32	172	39	18	22
23	114	50	6	145	21	1	173	34	29	23
24	115	53	37	146	19	19	174	29	38	24
25	116	56	59	147	17	28	175	24	45	25
26	118	0	11	148	15	27	176	19	50	26
27	119	3	14	149	13	16	177	14	53	27
28	120	6	8	150	10	57	178	9	56	28
29	121	8	51	151	8	28	179	4	58	29
30	122	11	24	152	5	51	180	0	0	30

When the Signs exceed 6 ſubtract 6 therefrom, and to the Right Aſcenſion of the Remainder add 180 Deg.

TABLE of Right Ascension in Time to every Degree of the ECLIPTIC.

Signs	0			1			2			Signs
°	Ho.	Min.	Se.	Ho.	Min.	Se.	Ho.	Min.	Se.	°
0	0	0	0	1	51	37	3	51	14	0
1	0	3	40	1	55	26	3	55	25	1
2	0	7	20	1	59	16	3	59	36	2
3	0	11	0	2	3	7	4	3	47	3
4	0	14	41	2	6	58	4	7	59	4
5	0	18	21	2	10	50	4	12	12	5
6	0	22	1	2	14	43	4	16	26	6
7	0	25	42	2	18	36	4	20	40	7
8	0	29	23	2	22	30	4	24	54	8
9	0	33	4	2	26	25	4	29	10	9
10	0	36	45	2	30	20	4	33	25	10
11	0	40	26	2	34	16	4	37	42	11
12	0	44	8	2	38	12	4	41	58	12
13	0	47	50	2	42	10	4	46	16	13
14	0	51	32	2	46	8	4	50	33	14
15	0	55	14	2	50	6	4	54	52	15
16	0	58	56	2	54	6	4	59	10	16
17	1	2	40	2	58	6	5	3	29	17
18	1	6	23	3	2	7	5	7	49	18
19	1	10	7	3	6	9	5	12	8	19
20	1	13	51	3	10	11	5	16	28	20
21	1	17	35	3	14	14	5	20	49	21
22	1	21	20	3	18	18	5	25	9	22
23	1	25	5	3	22	22	5	29	30	23
24	1	28	51	3	26	29	5	33	51	24
25	1	32	37	3	30	34	5	38	12	25
26	1	36	24	3	34	40	5	42	34	26
27	1	40	12	3	38	48	5	46	55	27
28	1	43	59	3	42	56	5	51	17	28
29	1	47	48	3	47	5	5	55	38	29
30	1	51	37	3	51	14	6	0	0	30

When the Signs exceed 6 subtract 6 therefrom, and to the Right Ascension of the Remainder add 12 Hours.

TABLE *of* Right Aſcenſion *in* Time *to* each Degree *of the* ECLIPTIC.

Signs	3			4			5			Signs
°	Ho.	Min.	Se.	Ho.	Min.	Se.	Ho.	Min.	Se.	°
0	6	0	0	8	8	45	10	8	23	0
1	6	4	22	8	12	55	10	12	12	1
2	6	8	43	8	17	4	10	16	1	2
3	6	13	5	8	21	12	10	19	49	3
4	6	17	26	8	25	20	10	23	36	4
5	6	21	48	8	29	26	10	27	33	5
6	6	26	9	8	33	32	10	31	19	6
7	6	30	30	8	37	38	10	34	55	7
8	6	34	51	8	41	42	10	38	40	8
9	6	39	11	8	45	46	10	42	25	9
10	6	43	32	8	49	49	10	46	10	10
11	6	47	52	8	53	52	10	49	54	11
12	6	52	11	8	57	53	10	53	37	12
13	6	56	31	9	1	54	10	57	21	13
14	7	0	50	9	5	54	11	1	4	14
15	7	5	8	9	9	54	11	4	46	15
16	7	9	26	9	13	52	11	8	29	16
17	7	13	44	9	17	50	11	12	11	17
18	7	18	2	9	21	48	11	15	52	18
19	7	22	18	9	25	44	11	19	34	19
20	7	26	35	9	29	40	11	23	15	20
21	7	30	50	9	33	36	11	26	56	21
22	7	35	6	9	37	30	11	30	37	22
23	7	39	20	9	41	24	11	34	18	23
24	7	43	34	9	45	17	11	37	58	24
25	7	47	48	9	49	10	11	41	39	25
26	7	52	1	9	53	2	11	45	19	26
27	7	56	13	9	56	53	11	49	0	27
28	8	0	24	10	0	44	11	52	40	28
29	8	4	35	10	4	34	11	56	20	29
30	8	8	45	10	8	23	12	0	0	30

When the Signs exceed 6 ſubtract 6 therefrom, and to the Right Aſcenſion of the Remainder add 12 Hours.

Equation *to be applied to the* Right Ascensions *of the* Ecliptic *for* Points *of the* Zodiac, *having* Latitude.

Longitude.		Lat. North in ♈ ♉ ♊ / Lat. South in ♎ ♏ ♐ } Subtract										Longitude.	
		1		3		5		7		9			
		°	'	°	'	°	'	°	'	°	'		
♈	♎	0	23	1	11	1	59	2	47	3	37	30	
	3	0	23	1	11	1	59	2	47	3	37	27	
	6	0	23	1	11	1	59	2	47	3	36	24	
	9	0	23	1	11	1	58	2	48	3	36	21	
	12	0	23	1	10	1	58	2	48	3	35	18	
	15	0	23	1	10	1	57	2	46	3	34	15	
	18	0	23	1	9	1	55	2	44	3	32	12	
	21	0	23	1	9	1	53	2	42	3	30	9	
	24	0	22	1	8	1	51	2	40	3	28	6	
	27	0	22	1	6	1	50	2	37	3	25	3	
♉	♏	0	21	1	5	1	49	2	35	3	22	♍	♓
	3	0	2	1	3	1	47	2	31	3	18	27	
	6	0	20	1	2	1	44	2	28	3	13	24	
	9	0	20	1	1	1	42	2	24	3	9	21	
	12	0	19	0	58	1	38	2	19	3	3	18	
	15	0	18	0	55	1	33	2	13	2	55	15	
	18	0	17	0	53	1	30	2	8	2	48	12	
	21	0	17	0	51	1	26	2	2	2	39	9	
	24	0	16	0	48	1	21	1	55	2	29	6	
	27	0	15	0	45	1	16	1	48	2	20	3	
♊	♐	0	14	0	41	1	10	1	40	2	10	♌	♒
	3	0	13	0	39	1	5	1	31	1	59	27	
	6	0	11	0	34	0	58	1	22	1	48	24	
	9	0	10	0	30	0	52	1	14	1	36	21	
	12	0	8	0	26	0	44	1	3	1	24	18	
	15	0	7	0	22	0	38	0	54	1	11	15	
	18	0	6	0	18	0	30	0	43	0	58	12	
	21	0	4	0	13	0	23	0	33	0	44	9	
	24	0	3	0	9	0	15	0	23	0	31	6	
	27	0	1	0	4	0	7	0	11	0	16	3	
	30	0	0	0	0	0	0	0	0	0	0	♋	♑
		1		3		5		7		9			
South		Lat. North in ♑ ♒ ♓ / Lat. South in ♋ ♌ ♍ } Add											
North													

Equation *to be applied to the* Right Aſcenſions *of the* Ecliptic *for* Points *of the* Zodiac, *having* Latitude.

Lat. South in ♈ ♉ ♊ / Lat. North in ♎ ♏ ♐ } Add

Longitude.		1 °	1 ′	3 °	3 ′	5 °	5 ′	7 °	7 ′	9 °	9 ′	Longitude.	
♈	♎	0	24	1	11	1	59	2	47	3	36	30	
	3	0	23	1	11	1	59	2	47	3	35	27	
	6	0	23	1	11	1	59	2	47	3	34	24	
	9	0	23	1	11	1	58	2	46	3	32	21	
	12	0	23	1	11	1	58	2	45	3	30	18	
	15	0	23	1	10	1	57	2	43	3	28	15	
	18	0	23	1	9	1	55	2	41	3	26	12	
	21	0	22	1	9	1	53	2	39	3	23	9	
	24	0	22	1	8	1	52	2	36	3	20	6	
	27	0	22	1	6	1	50	2	33	3	15	3	
♉	♏	0	22	1	4	1	47	2	28	3	10	♍	♓
	3	0	21	1	3	1	44	2	25	3	5	27	
	6	0	20	1	2	1	42	2	21	2	59	24	
	9	0	19	0	59	1	38	2	15	2	54	21	
	12	0	19	0	57	1	34	2	10	2	45	18	
	15	0	19	0	55	1	31	2	6	2	39	15	
	18	0	18	0	52	1	27	2	0	2	31	12	
	21	0	17	0	49	1	21	1	54	2	22	9	
	24	0	16	0	47	1	17	1	47	2	13	6	
	27	0	15	0	44	1	12	1	39	2	4	3	
♊	♐	0	14	0	41	1	7	1	32	1	55	♌	♒
	3	0	12	0	37	0	58	1	25	1	45	27	
	6	0	11	0	33	0	49	1	16	1	34	24	
	9	0	10	0	30	0	42	1	8	1	23	21	
	12	0	9	0	26	0	35	0	58	1	12	18	
	15	0	7	0	21	0	31	0	49	1	0	15	
	18	0	6	0	17	0	22	0	40	0	49	12	
	21	0	5	0	13	0	15	0	30	0	37	9	
	24	0	3	0	9	0	9	0	20	0	24	6	
	27	0	1	0	4	0	4	0	10	0	13	3	
	30	0	0	0	0	0	0	0	0	0	0	♋	♑
		1		3		5		7		9			

Lat. North in ♑ ♒ ♓ / Lat. South in ♋ ♌ ♍ } Subtract

Equation *to be subtracted from the* Latitude *of a* Planet, *which gives the* Difference *betwixt its* Declination *and the* Declination *of its* Point *in the* Ecliptic.

Longitude.	Degrees *of* Latitude. 1	2	3	4	5	6	Longitude.
°	′	′	′	′	′	′	°
♈ ♎	5	10	15	20	25	30	30
3	5	10	15	20	25	30	27
6	5	10	15	20	25	30	24
9	5	10	15	20	25	29	21
12	5	10	15	19	24	29	18
15	5	10	14	19	24	28	15
18	5	9	14	18	23	27	12
21	4	9	14	18	22	26	9
24	4	8	13	17	21	25	6
27	4	8	13	17	20	24	3
♉ ♏	4	8	12	16	19	23	♍ ♓
3	4	8	11	15	18	22	27
6	4	7	10	14	17	21	24
9	3	6	9	13	16	20	21
12	3	6	9	12	15	18	18
15	3	6	8	11	14	17	15
18	3	5	7	10	13	16	12
21	3	5	6	9	12	14	9
24	2	4	6	8	10	13	6
27	2	4	5	7	9	11	3
♊ ♐	2	3	4	6	7	9	♌ ♒
3	2	2	3	5	6	8	27
6	2	2	3	4	5	6	24
9	1	2	2	3	4	5	21
12	1	1	2	2	3	4	18
15	1	1	1	1	2	3	15
18	1	1	1	1	1	2	12
21	0	0	0	0	0	1	9
24	0	0	0	0	0	0	6
27	0	0	0	0	0	0	3
30	0	0	0	0	0	0	♋ ♑

ROTATION *of the* EARTH.

Time. Ho.	°	′	″	Time. Sec. Min.	′ °	″ ′	‴ ″	Time. Sec. Min.	′ °	″ ′	‴ ″
1	15	2	28	1	0	15	2	31	7	46	16
2	30	4	56	2	0	30	5	32	8	1	18
3	45	7	24	3	0	45	7	33	8	16	21
4	60	9	51	4	1	0	10	34	8	31	24
5	75	12	19	5	1	15	12	35	8	46	26
6	90	14	47	6	1	30	15	36	9	1	28
7	105	17	15	7	1	45	17	37	9	16	31
8	120	19	43	8	2	0	20	38	9	31	34
9	135	22	11	9	2	15	22	39	9	46	36
10	150	24	38	10	2	30	25	40	10	1	38
11	165	27	6	11	2	45	27	41	10	16	41
12	180	29	34	12	3	0	30	42	10	31	44
13	195	32	2	13	3	15	32	43	10	46	46
14	210	34	30	14	3	30	35	44	11	1	48
15	225	36	57	15	3	45	37	45	11	16	51
16	240	39	25	16	4	0	39	46	11	31	54
17	255	41	53	17	4	15	42	47	11	46	56
18	270	44	21	18	4	30	44	48	12	1	58
19	285	46	49	19	4	45	47	49	12	17	1
20	300	49	17	20	5	0	49	50	12	32	4
21	315	51	44	21	5	15	52	51	12	47	6
22	330	54	12	22	5	30	54	52	13	2	8
23	345	56	40	23	5	45	57	53	13	17	11
24	360	59	8	24	6	0	59	54	13	32	14
				25	6	16	2	55	13	47	16
				26	6	31	4	56	14	2	18
One Revolution.				27	6	46	7	57	14	17	20
h.	′	″	‴	28	7	1	9	58	14	32	22
23	56	4	6	29	7	16	11	59	14	47	25
				30	7	31	14	60	15	2	28

Declination of the Moon.	Equation *to be added to the* Horizontal Diameter ☽.									
	Horiz. Diam. 29′ 30″		30′ 0″		30′ 30″		31′ 0″		31′ 30″	
Gr.	′	″	′	″	′	″	′	″	′	″
1	+		+		+		+		+	
2	0	1	0	1	0	1	0	1	0	1
3	0	2	0	2	0	2	0	2	0	2
4	0	4	0	4	0	4	0	4	0	4
5	0	7	0	7	0	7	0	7	0	7
6	0	10	0	10	0	10	0	10	0	10
7	0	13	0	13	0	13	0	14	0	14
8	0	17	0	17	0	17	0	18	0	18
9	0	22	0	22	0	22	0	23	0	23
10	0	27	0	27	0	28	0	28	0	29
11	0	33	0	33	0	34	0	34	0	35
12	0	40	0	40	0	41	0	42	0	42
13	0	47	0	47	0	48	0	49	0	50
14	0	54	0	55	0	56	0	57	0	58
15	1	2	1	3	1	4	1	5	1	7
16	1	11	1	12	1	13	1	14	1	16
17	1	21	1	22	1	23	1	24	1	26
18	1	31	1	32	1	34	1	35	1	37
19	1	42	1	43	1	45	1	47	1	49
20	1	54	1	55	1	57	1	59	2	1
21	2	6	2	8	2	10	2	12	2	14
22	2	19	2	21	2	24	2	26	2	28
23	2	33	2	35	2	38	2	41	2	43
24	2	47	2	50	2	53	2	56	2	59
25	3	2	3	5	3	9	3	12	3	15
26	3	18	3	22	3	25	3	29	3	32
27	3	36	3	40	3	43	3	47	3	51
28	3	55	3	59	4	3	4	7	4	11
29	4	14	4	19	4	23	4	27	4	31
30	4	34	4	39	4	43	4	48	4	52

Declination of the Moon.	Equation *to be added to the* Horizontal Diameter ☽.									
	Horiz. Diam. 32′ 0″		32′ 30″		33′ 0″		33′ 30″		34′ 0″	
Gr.	′	″	′	″	′	″	′	″	′	″
1	+		+		+		+		+	
2	0	1	0	1	0	1	0	1	0	1
3	0	3	0	3	0	3	0	3	0	3
4	0	5	0	5	0	5	0	5	0	5
5	0	7	0	7	0	7	0	7	0	7
6	0	11	0	11	0	11	0	11	0	11
7	0	14	0	15	0	15	0	15	0	15
8	0	18	0	19	0	19	0	20	0	20
9	0	23	0	24	0	24	0	25	0	25
10	0	29	0	30	0	30	0	31	0	31
11	0	36	0	37	0	37	0	38	0	38
12	0	43	0	44	0	44	0	45	0	46
13	0	51	0	52	0	52	0	53	0	54
14	0	59	1	0	1	1	1	2	1	3
15	1	8	1	9	1	10	1	11	1	12
16	1	17	1	19	1	20	1	21	1	22
17	1	27	1	29	1	31	1	32	1	33
18	1	38	1	40	1	42	1	43	1	45
19	1	50	1	52	1	54	1	56	1	58
20	2	3	2	5	2	7	2	9	2	11
21	2	17	2	19	2	21	2	23	2	25
22	2	31	2	33	2	35	2	38	2	40
23	2	46	2	48	2	51	2	54	2	56
24	3	1	3	4	3	7	3	10	3	13
25	3	18	3	21	3	25	3	28	3	31
26	3	36	3	40	3	44	3	47	3	50
27	3	55	3	59	4	3	4	6	4	10
28	4	15	4	19	4	23	4	27	4	31
29	4	36	4	40	4	44	4	49	4	53
30	4	57	5	1	5	6	5	11	5	16

DECIMAL TABLE *for* Minutes *of a* Degree.				DECIMAL TABLE *for* Seconds *of a* Degree.			
′	Dec.	′	Dec.	″	Dec.	″	Dec.
1	.016	31	.516	1	.00027	31	.00861
2	.03	32	.53	2	.0005	32	.008
3	.05	33	.55	3	.00083	33	.00916
4	.06	34	.56	4	.001	34	.0094
5	.083	35	.583	5	.00138	35	.00972
6	.1	36	.6	6	.0016	36	.01
7	.116	37	.616	7	.00194	37	.01027
8	.13	38	.63	8	.002	38	.0105
9	.15	39	.65	9	.0025	39	.01083
10	.16	40	.6	10	.0027	40	.01
11	.183	41	.683	11	.00305	41	.01138
12	.2	42	.7	12	.003	42	.0116
13	.216	43	.716	13	.00361	43	.01194
14	.23	44	.73	14	.0038	44	.012
15	.25	45	.75	15	.00416	45	.0125
16	.26	46	.76	16	.004	46	.0127
17	.283	47	.783	17	.00472	47	.01305
18	.3	48	.8	18	.005	48	.013
19	.316	49	.816	19	.00527	49	.01361
20	.3	50	.83	20	.005	50	.0138
21	.35	51	.85	21	.00583	51	.01416
22	.36	52	.86	22	.0061	52	.014
23	.383	53	.883	23	.00638	53	.01472
24	.4	54	.9	24	.006	54	.015
25	.416	55	.916	25	.00694	55	.01527
26	.43	56	.93	26	.0072	56	.015
27	.45	57	.95	27	.0075	57	.01583
28	.46	58	.96	28	.007	58	.0161
29	.483	59	.983	29	.00805	59	.01638
30	.5	60	1.000	30	.008	60	.016

TABLE *of the* Meridian Angle, *or* Angle *of the* Points *of the* Ecliptic *with the* Meridian.

	♈			♉			♊			
	°	′	″	°	′	″	°	′	″	
0	66	31	0	69	22	50	77	44	38	30
1	66	31	12	69	34	27	78	6	20	29
2	66	31	46	69	45	26	78	28	17	28
3	66	32	44	69	58	46	78	50	31	27
4	66	34	3	70	11	30	79	13	1	26
5	66	35	47	70	24	25	79	35	45	25
6	66	37	54	70	38	1	79	58	43	24
7	66	40	23	70	51	51	80	21	54	23
8	66	43	16	71	6	3	80	45	20	22
9	66	46	30	71	20	36	81	9	1	21
10	66	50	8	71	35	30	81	32	53	20
11	66	54	8	71	50	45	81	56	57	19
12	66	58	34	72	6	23	82	21	13	18
13	67	3	20	72	22	20	82	45	38	17
14	67	8	30	72	38	40	83	10	15	16
15	67	14	2	72	55	21	83	35	3	15
16	67	19	58	73	12	22	84	0	0	14
17	67	26	15	73	29	43	84	25	5	13
18	67	32	56	73	47	25	84	50	18	12
19	67	40	2	74	5	26	85	15	40	11
20	67	47	30	74	23	46	85	41	8	10
21	67	55	20	74	42	28	86	6	43	9
22	68	3	33	75	1	30	86	32	24	8
23	68	12	7	75	20	50	86	58	9	7
24	68	21	6	75	40	27	87	23	59	6
25	68	30	28	76	0	25	87	49	54	5
26	68	40	10	76	20	41	88	15	51	4
27	68	50	16	76	41	13	88	41	50	3
28	69	0	47	77	2	5	89	7	52	2
29	69	11	37	77	23	13	89	33	55	1
30	69	22	50	77	44	38	90	0	0	0
	♓			♒			♑			

TABLE *of the* Meridian Angle, *or* Angle *of the* Points *of the* Ecliptic *with the* Meridian.

	♋			♌			♍			
	°	′	″	°	′	″	°	′	″	
0	90	0	0	102	15	22	119	37	10	30
1	90	26	5	102	36	47	110	48	23	29
2	90	52	8	102	57	55	110	59	18	28
3	91	18	10	103	18	47	111	9	44	27
4	91	44	9	103	39	19	111	19	50	26
5	92	10	6	103	59	35	111	29	32	25
6	92	36	1	104	19	33	111	38	54	24
7	93	1	51	104	39	10	111	47	53	23
8	93	27	36	104	58	30	111	56	27	22
9	93	53	17	105	17	32	112	4	40	21
10	94	18	52	105	36	14	112	12	30	20
11	94	44	20	105	54	34	112	19	58	19
12	95	9	42	106	12	35	112	27	4	18
13	95	34	55	106	30	17	112	33	45	17
14	96	0	0	106	47	38	112	40	2	16
15	96	24	57	107	4	39	112	45	58	15
16	96	49	45	107	21	20	112	51	30	14
17	97	14	22	107	37	40	112	56	40	13
18	97	38	47	107	53	37	113	1	26	12
19	98	3	3	108	9	15	113	5	52	11
20	98	27	7	108	24	30	113	9	52	10
21	98	50	59	108	39	24	113	13	30	9
22	99	14	40	108	53	57	113	16	44	8
23	99	38	6	109	8	9	113	19	37	7
24	100	1	17	109	21	59	113	22	6	6
25	100	24	15	109	35	25	113	24	13	5
26	100	46	59	109	48	30	113	25	57	4
27	101	9	29	110	1	14	113	27	16	3
28	101	31	43	110	13	34	113	28	14	2
29	101	53	40	110	25	33	113	28	48	1
30	102	15	22	110	37	10	113	29	0	0
	♐			♏			♎			

To discover the Number of Eclipses *and the Time of their happening, in any Year requir'd.*

First, FIND the Place of the Node on the First of *January* for the said Year, to which adding six Signs, gives the Place of the other Node, they being always opposite to each other.

Secondly, Observe what Months the Sun enters those Signs, wherein the Nodes are, which is immediately discovered by the Figure at the Beginning of the Book.

Thirdly, Find the Place of the Sun on the First Day of each of the said Months.

Then, with the Prosthapheresis for reducing the Moon's Mean Place on each respective Day in the Year 1736 to that for the Year requir'd, if the same be additive (as it will always be for Years forward) subtract it from the aforesaid Places of the Sun, and seek the Remainder, or next less, among the Moon's Mean Places in the said Months of the Year 1736, adding so many Degrees to the said Remainder as are the Number of Days from the First of the said Month exclusive. The Day answering to this last Sum is that whereon the Change of the Moon happens, and the Difference by which this last Sum exceeds the Numbers against the said Day, being multiplied by 2, gives the Time of the Day according to the Mean Motions.

If

If the aforeſaid Proſthaphereſis be ablative, (as it may be for Time paſt) it muſt then be added to the Place of the Sun, operating in all other reſpects as before.

If the Change of the Moon, thus found, happens within * 18 Deg. either before or after the Node, there will be an Eclipſe of the Sun, otherwiſe not.

* This tho' not at all Times the exact Limit, yet it may be taken as ſuch for Eſtimation.

If from the aforeſaid laſt Sum be alſo ſubtracted 1 Sign, it will give the Numbers for diſcovering in like manner the Day of the preceding Change; and if to the ſame there be added 1 Sign, it will give thoſe for diſcovering the Day of the ſubſequent, when, by the aforeſaid Circumſtances, may be found if there will be an Eclipſe, or not.

Laſtly, If from the Numbers for thus diſcovering the Change, you ſubtract $6^{s}\ 15^{\circ}$ you will have the Numbers for diſcovering the Day of the preceding; and by adding $6^{s}\ 15^{\circ}$ thoſe for diſcovering the Day of the ſubſequent Oppoſition of the Moon.

Which, if ſhould happen within * 12° either before or after the Node, there will be an Eclipſe of the Moon, otherwiſe not.

* As above.

N.B. If the Month be *January* or *February*, and it be not Leap-Year, the Day thus found will be a Day leſs, *viz.* 29 the 28th, *&c.*

Having

Having thus discovered the Mean Time of an Eclipse, proceed to find out the Places of the Moon's Mean Longitude, Apogé, *&c.* by which means you may ever (in such Cases) estimate near enough the Elliptic Equation, which apply to the aforefound Mean Place of the Moon at the estimated Time of the Conjunction or Opposition; next see how far this last Place is short or beyond the said Conjunction or Opposition, which Distance, being multiplied by 2, gives the Hour, *&c.* to be added to the said estimated Time; in the first Case and subtracted, in the latter, which will always to a few Minutes give the true Time, to which if you now calculate as if it was the True, the Excess or Defect will be easily obtained by the Hourly Motion of the Moon from the Sun, which will be explained in the following Examples.

First, Let the Number of the Eclipses for the Year 1739 be required.

The * Mean Place of the Node to Degrees, which at present is sufficient, will be found to be $4^s\ 13^\circ$, to which adding 6 Signs, gives $10^s\ 13^\circ$, *viz.* ♌ and ♒, which Signs the Sun is found to enter in the Months of *January* and *July*.

* Which in Eclipses is ever within a Degree of the True, and may be found, if Occasion.

The true Place of the Sun on the First of *January* to Min. is $9^s\ 20^\circ\ 55'$, which in this Case may be taken $9^s\ 21^\circ$. The Prosthapheresis for the Reduction of the Moon's Places 1736 to 1739, is $0^s\ 28^\circ$ additive, (also near enough

enough for the present Purpose) which, being subtracted from the aforesaid Place of the Sun $9^s\ 21^\circ$, gives $8^s\ 23^\circ$, against which, among the Mean Places of the Moon in the said Month, answers 27th Day *(ferè)* to the said $8^s\ 23^\circ$; now adding 26° for the Number of Days, exclusive from the First of the Month, gives $9^s\ 19^\circ$ which, seeking again in the Table, against *January* 28. (which, as being not Leap-Year, is 27.) you have $9^s\ 8^\circ$, and there being an Increase of a Day, a Degree more must be added to $9^s\ 19^\circ$, which gives $9^s\ 20^\circ$, the Difference 12°, being multiplied by 2, gives 24 Hours, *viz.* the Noon of the next Day, for the Mean Time of the Change, which is within 7 Hours of the True, at which Time the Mean Place of the Node, answering to the said Day of the Month, is $10^s\ 11^\circ$; next, adding 27°, *viz.* 1 Degree *per Diem*, to the aforesaid Place of the Sun on the 1° of the Month, *viz.* $9^s\ 21^\circ$, gives $10^s\ 18^\circ$, which is within 7° of the said Node, and consequently there will then be an Eclipse of the Sun.

Again, If from this last Sum, *viz.* $9^s\ 20^\circ$ you subtract $6^s\ 15^\circ$, and seek the Remainder, *viz.* $3^s\ 5^\circ$, among the Mean Places of the Moon; also in the said Month on the 14th Day (which is here to be 13°) you have 3 3°, the Difference 2, being multiplied by 2, gives 4 Hours after Noon for the preceding Opposition, and is also within 7 Hours of the True; next, adding 13°, the Number of Days from the First of the Month exclusive, to the aforesaid Place of the Sun on the First of the Month; *viz.* $9^s\ 21^\circ$, gives $10^s\ 4^\circ$, at which Time

Time alſo the Mean Place of the Node will be found to be $10^s\ 12^\circ$, the Difference 8°, being within the Limits, *viz.* 12°, ſhews there will alſo be an Eclipſe of the Moon at the ſaid Oppoſition.

The like Method is to be uſed with the preceding and ſubſequent Change and Oppoſitions, if found requiſite.

Proceeding in the ſame Manner for the Month of *July*, the true Place of the Sun will be found to be $3^s\ 19^\circ\ 32'$, or $3^s\ 20^\circ$, from which ſubtracting $0^s\ 28^\circ$ as before, gives $2^s\ 22^\circ$ the neareſt Number, to which among the Moon's Mean Places in the ſaid Month anſwers 22d Day, and then 21° for 21 Days from the Firſt of the ſaid Month, being added to the ſaid $2^s\ 22^\circ$, gives $3^s\ 13^\circ$, ~~which~~ next 2, by which it exceeds the ſaid Number againſt 24th Day, being multiplied by 2, gives 4 Hours after Noon for the Time of the Change, and is directly the Time.

Again, 23° for the Days from the Firſt of the Month, being added to the Sun's Place on the ſaid Firſt of the Month, *viz.* $3^s\ 20^\circ$, gives $4^s\ 13^\circ$ *ferè*, and the Mean Place of the Node will be found to be $4^s\ 2^\circ$, the Difference 11° being within the Limits there, will conſequently be an Eclipſe of the Sun.

Laſtly, If from this laſt Sum, *viz.* $3^s\ 15^\circ$ there be ſubtracted $6^s\ 15^\circ$, and the Remainder 9^s ſought out among the Moon's Mean Places, the Oppoſition will be found to be on the

the 9th Day, at 8 at Night, Mean Time (which is about 4 Hours from the True) the Place of the Sun 3^s $28°$ *ferè*, and the Mean Place of the Node 4^s $3°$, which being but $5°$ distant, and therefore within the Limits, there consequently will be an Eclipse of the Moon; and thus the whole Number of Eclipses will be found to be * Five for the said Year 1739; and in like manner may the Number of Eclipses be determined for any Year required.

Having thus given a general Method for finding the Mean Time of an Eclipse, as also their Number for any Year required, I shall next shew how to obtain the true Time.

In Eclipses of the Sun that are visible, it will be best to begin the Calculus at the Noon of the Day whereon the Eclipse happens, and of the Moon at 12 Ho. P.M. of the said Day.

Example.

Let it be required to obtain the true Time of the Opposition of the Sun and Moon in her Orb *March* 15. 1736. on which Day, by the aforesaid Rules, there may be found to have happened an Eclipse of the Moon. The Mean Places of the Moon, &c. will be found as follow, making use of but three Equations as in *Page* 164. but if you compute according to the Theory, you must then apply the other Equations, as by the Precepts before given, 'till you come to the Elliptic, when proceed as in this *Example.*

* It will be convenient sometimes to observe by the Place of either of the Nodes at the Beginning of the ensuing Year, if there will be any Eclipse at the latter End of the preceding, as in the present Year, which may be easily seen by the foregoing Rules.

1736, Equal Time *Mar.* 15. 12h. P. M.

☽ Me. Long.	s	°	′	″
	6	3	59	45
Ann. Equs.	—		12	5
	6	3	47	40
Ho. Paralx.			60	51
Ho. ½ Diar.			16	52

True Place ☉. 0s 26° 36′ 20″

s	°	′	″	Apogé.
11	0	52	35	
	+	21	56	
11	1	14	31	
1	5	21	49	Ap. à ☉.
	+ 10	38	54	2d. Equ. Ap.
11	11	53	25	Tr. Pl. Apo.
6	21	54	15	☽ Me. Ano.

Me. Anom. ☉ 8s 26° 26 21″

1736, Equal Time, *Mar.* 15. 12h. P. M.

s	°	′	″	☽ Node.
6	6	31	4	
		— 8	55	
6	6	22	9	
6	0	14	11	☊ à ☉
		+	11	2d. Equat. ☊.
6	6	22	20	Tr. Pl. ☊.
		14	0	☊ à Orbit.
		1	32	Lat. Nor. Aſc.

With

With the Mean Anomaly, *viz.* $6^s\ 22^\circ$ in this Case, entering the Table of the Mean Elliptic Equation, you have $2^\circ\ 29'\ 24''$, next with the Degrees of the Distance, ☽ Apogé à ☉ (which in this Case may be also taken in round Numbers) and the Complement of the Mean Anomaly, as it exceeds six Signs, entering the Table of Reduction, *&c.* you will have about $16'$ to be added to the aforesaid $2^\circ\ 29'\ 24''$, *i. e.* $2^\circ\ 45'\ 24''$ *ferè* for the true Elliptic Equation to be added to the aforesaid Place of the Moon first Equated, which gives $6^s\ 6^\circ\ 33'\ 4''$ about $3'$ short of the Opposition ☉, whence the aforesaid Time proves very near the True, to which Time, now calculating again, as if it was the True, the Difference will be easily found by the Hourly Motion of the Moon from the Sun.

In this Example, the true Place of the Moon in her Orb will be found to be $6^s\ 6^\circ\ 32'\ 55''$ that of the Sun, as before, $0^s\ 6^\circ\ 36'\ 20''$, the Distance of the Moon short of the Opposition $3'\ 25''$, the horary Motion of the Sun taken out of the Table (*Page* 272.) is $2'\ 28''$, the horary Motion of the Moon in her Orb, her Place being calculated for an Hour forwarder, will be found to be $37'\ 14''$, the Difference of these horary Motions is that of the Moon from the Sun, *viz.* $34'\ 46''$; the Proportion then for finding the Time of the true Orbit Opposition is, as $34'\ 46''$ is to $60'$, or an Hour, so is $3'\ 25''$, the Distance of the Moon from the said Orbit Opposition, to $5'\ 54''$, the Time (as the Moon was short of the Opposition) to

be added to the Eſtimated Time, as above, *viz.* Midnight, or 12 Ho. P. M. and thus the true Orbit Oppoſition is found to be 12 ho. 5′ 54″ P. M. Equal Time.

If you would know the Places of the Luminaries at the ſaid Time, it will be as an Hour (or 60′) is to 37′ 14″, the Space deſcribed by the Moon in an Hour, ſo is 5′ 54″ to 3′ 39″, which added to her Place, when ſhort as before of the Oppoſition, *viz.* 6ˢ 6° 36′ 34″, her true Place, that of the * Sun being the direct Oppoſite.

* If to this laſt Time, *viz.* 12 ho. 5 m. 54 ſec. the Places of the Luminaries be again calculated, they will be found directly oppoſite.

For a further Proof of this, if the Sun in an Hour, or 60′, moves 2′ 28″, what will he move in 5′ 54″, Anſwer 14″; which added to the aforeſaid Place of the Sun, makes it the ſame with that of the Moon, as laſt found, deducting 6ˢ for the Oppoſition.

If the Calculus of the Moon's Place for an Hour forward or backward may at any Time be thought irkſome, it may be obtained with great accuracy in the Zyzygys by the following Method.

Firſt, It is to obſerved, that the Mean Hourly Motion of the Moon at a Mean Diſtance and Mean Eccentricity, (at which Time the Mean Horizontal Parallax takes place, *viz.* 57′ 30″,) is ever 33′ 33″.

Next, take the Difference between the preſent Horizontal Parallax and the Mean, which being multiplied by the conſtant Factor 1.12, the

and the Product added to, or ſubtracted from, the ſaid Mean Hourly Motion, according as the preſent Horizontal Parallax is greater or leſſer than the Mean, will give the preſent Hourly Motion required.

In this Example the Horizontal Parallax is 60′ 51″ greater than the Mean by 3′ 21″, which multiplied by the aforeſaid Conſtant Factor 1.12, gives 3′ 43″ to be added to the Mean hourly Motion 33′ 33″, which gives 37′ 16″ exceeding that found by Calculation by 2″ only.

The ſame Method of obtaining the true Time is to be obſerved in Eclipſes of the Sun.

Having thus exhibited the Neceſſaries preparatory to the Calculating of Eclipſes, I refer the Reader to thoſe Books that treat thereof, the which, to handle fully with their Conſtructions, the Occultations of the fix'd Stars, *&c.* requires a Treatiſe of itſelf. The Deſign of this, which was to remove the labourious and tedious Operations hitherto uſed in obtaining the Moon's Place, being thus ended, I ſhall next proceed to the Deſcription and Uſes of the Chronologer.

THE

THE Description *and* Use OF THE CHRONOLOGER.

THE Circumferences of the four exteriour concentric Circles round the Square in the left-hand Diagram are divided into 12 Parts, answering to the 12 Months of the Year; between the two exteriour are contain'd the Mean Places of the Sun, and between the two next the Mean Anomalies, and under these the Months with the first Day, and the Number of Days in each respective Month; which indicates, that on the first Day of the Month at Noon, the Mean Places of the Sun and Anomaly were as above express'd, in the said respective Month in the Radical Year 1736, which is placed in the four several Parts round the Square.

The three next are divided into two equal Parts, and immediately under the Months of *January*, *February* and *March*, is contain'd the Sun's Mean Motion for every fourth or Leap Year express'd in decimal Parts of a Deg. as also his Mean

Mean Motion for every ſingle Year, or Year after Leap-Year (which can never exceed three) *viz.* — 14′ 20″, or 14 Minutes and 20 Seconds Negative, being the Quantity he falls ſhort of the firſt Point of *Aries* (from which all the Mean Motions are computed) in a Year of 365 Days, and under theſe again the Mean Motion of the Moon for every fourth and ſingle Year is expreſs'd in decimal Parts of the Circle, or 360 Deg.

Immediately under the Months of *April*, *May* and *June*, are the Motions of the Sun's Mean Anomaly expreſs'd as before, and likewiſe thoſe of the Moon's Apogé decimally expreſs'd as before. Next immediately under the Months *July*, *Auguſt* and *September*, are the Mean Motions of the Sun and Anomaly for a Day, expreſs'd in decimal Parts of a Deg. and and under theſe again, the Mean Motions of the Moon's Node for every 4th, *viz.* leap and ſingle Year expreſs'd in the decimal Part of the Circle, or 360 Deg.

Laſtly, Under the Months *October*, *November* and *December*, are the Sun's Mean Motions and Anomaly for an Hour and a Minute, expreſs'd in Min. and decimal Parts of a Min, *&c.* as likewiſe the Mean Motions of the Moon for a Day and an Hour expreſs'd in decimal Parts of the Circle.

The Tables in the Square are ſufficiently explain'd *per* their Titles; but if any thing ſhould ſeem obſcure, it will be fully clear'd up in the enſuing Examples.

In

In this Right Hand Diagram the Mean Places of the Moon Apogé and Node, *&c.* are digested as before of the Sun.

Between the two last concentric Circles under the Months of *January*, *February* and *March*, are contain'd the decimal Multipliers to the 1° Equation of the Moon, as also of the Apogé ×r signifying Multiplier.

Under the Months of *April*, *May* and *June*, are the Multipliers to the 1° Equation of the Node, and the Motion of the Apogé for one Day.

Under the Months of *July*, *August* and *September*, are the Motions of the Apogé for an Hour, and of the Node for a Day. And next follows the Motion of the Node for an Hour; and under these again, about the Square, the Radical Year, *viz.* 1736.

The Titles of the Tables in this Square also as before of the Sun's, declare their Uses, which will likewise be made conspicuous *per* the following Examples.

In the Table for finding the Dominical Letter for ever by the Cycle of the Sun; after having found the said Cycle *per* the Rule there laid down, seek the same in the said Table, and against it you have the Dominical Letter required; if there be two, as there will be every Leap-year, then the first is to be used to 24 *February*, and the other all the Year after.

Seek

Seek the Dominical Letter thus found among the Seven immediately under those of the Cycle; when the 1st Day of the Month, or each of the Months immediately under the said Dominical Letter begins on a Sunday, the Month or Months under the next Letter to the right Hand on a *Monday*, the next *Tuesday*, and so on till you come to the Dominical Letter again, under which you will also find the Day of the Month that *Advent Sunday* falls on.

Under the Dominical Letter at the Head of the Table for finding *Easter* for ever, and against the Prime (found *per* the Precept in the Table of the Cycle of the Sun) you have the Day of the Month that *Easter* falls on; the Month next above in the said Column, if not found directly against the said Prime.

The Terms, Returns, *&c.* may all be found by Inspection *per* the Precepts in the Table of the Cycle of the Sun.

Having thus given what was previously necessary to working Examples, I shall next proceed thereto in all the various Cases of the Chronologer.

As the Sun is the Basis of all these Calculations, I shall first begin with computing his Place; accordingly let it be required (as before) for * *December* 12, 1738. at $5^{h}. 27'$ P.M.

 First

* And here it is to be always noted, that if the Months be *January* and *February*, and not Leap-year, you must always compute for a Day forwarder, *viz.* for 12th must be taken 13th, *&c.*

First take out the Mean Places of the Sun and Anomaly, answering to the first of *December* in the Chronologer, which will be $8^s\ 21^\circ\ 25'\ 46''$ the Mean Place, $5^s\ 13^\circ\ 10'\ 18''$ Mean Anomaly.

Next, as the Day required is the 12th, there are 11 Days more to Account for.

☉ Mo. *per* D.	Mo. Ano. *per* D.
.9°8565	.9°856
11 Days.	11 Days.
10°.84215	10°.8416
60 *	60 *
50.5290	50.4960
60	60
31.74	29.76
☉ Me. Mo.	Anom.
That is 10°. 50′ 32″.	10°. 50′. 30″.

* Vide Pag. 96. Ex. 1.

Next the Time required is 5h 27′ that is decimally express'd 5.45 the Mean Motion of the Sun and likewise of the Anomaly for one Hour is

2′.4641
Multiply by 5.45

12.3205
98564
123205

13′.429405
60

that is 13′ 26″ 2″5.76433

which

which added to the Sun's Mean Motion and Anomaly for 11 Days found as above, gives 11° 3′ 58″ Mean Motion and 11° 3′ 56″ Mean Anomaly to be added to those before taken out on the first of *December*, which gives

☉ Mean Place	☉ Mean Anom.
9ˢ 2° 29′ 44″	5ˢ 24° 14′ 14″

at the Time required for the Year 1736, which now must be reduced to the Year required 1738, *per* Example Pag. 105, *viz.* as it is only two Years from the Radix, there must be twice the Numbers answering to the Motions of a single Year, for the Mean Place and Anomaly be respectively deducted therefrom, *viz.* twice 14′ 20″ *i. e.* 28′ 40″ for the Mean Place, and twice 15′ 20″ *i. e.* 30′ 40″ for the Mean Anomaly, which gives for *December* 12, 1738, at 5 Hours 27 Min. P. M.

☉ Mean Place	Mean Anom.	☉ Apogé
9ˢ 2° 1′ 4″	5ˢ 23° 43′ 34″	3ˢ 8° 17′ 30″

The Place of the Apogé is obtained as *per* a former Precept by subtracting the ☉ Mean Anomaly from his Mean Place.

Then for the Equation of the Sun's Centre entering the Table of that Title, with the ☉ Mean Anomaly above found against the next less in the said Table, *viz.* 5ˢ at the Head, and 22° in the Margin, you have * 991″, and against 24° and under 5ˢ at the Head the next greater than the present Mean Anomaly you have 744″ the difference of these is 247″. Whence it will be as 2 Deg. (which is always the Marginal diff.) is to 247″ so is the diff. between

* The Numbers in this Table are all Seconds for conveniency and ease in Computing.

tween the next less and present Mean Anomaly which is here 1° 43′ 34″ to the Seconds, to be applied to those against the said lesser Marginal Numbers than the Deg. of the present Mean Anomaly, *viz.* to be added if the same be increasing, but subtracted if decreasing; in this Example the 247″ is decreasing, and the diff. *viz.* 1° 43′ 34″ decimally express'd is,

$$\begin{array}{rr} & 1.726 \\ \text{Multiply by} & \underline{247} \\ & 12082 \\ & 6904 \\ & \underline{3452} \\ & 426.322 \end{array}$$

which being divided by 2, the Marginal diff. (that is always taking the half,) you have 213″ to be deducted from 991″ found as before, which gives 778″ (or 12′ 58″) the true Equation of the Sun's Centre in Seconds required, which being subtracted as the Table directs from the Mean Place of the Sun before found, *viz.* 9s 2° 1′ 4″ gives 9s 1° 48′ 6″ the true Place of the Sun required, and is exactly as before found *per* the Tables.

☞ This special regard is to be had with all the Tables, *viz.* when the Sign, &c. you enter with is not to be found at the Head, you must then subtract it from 12, which diff. you will always find there, when operate as before, but on the contrary, if the Head Title is subtract, you must then add, and if add, subtract the Equation so found.

Thus

Thus having obtain'd the Ground-work, *viz.* the Place of the Sun, I shall next proceed to the Uses of the Tables depending thereon.

And first for his Declination.

The Place of the Sun is 9. 1° 48′ which not being to be found at the Head of the Table, it must therefore be subtracted from 12, the difference is 2ˢ 28° 12′ which now being found there, and entering the Table of the Sun's Declination therewith under 2ˢ, and against the next less Marginal Deg. *viz.* 24° you have * 23°.347, the greatest Declination takes Place, next in the Table, which here may be taken 23.5. the difference is .153, whence it will be as 6° the Marginal difference is to 153, so is 4° 12′ the difference between the said Marginal N°. *&c.* the Numbers entered the Table with to .107 *ferè*, which added to 23°. 347 as the Difference was increasing gives 23. 454 the present Declination required.

* The Numbers of this Table are decimally express'd also for the ease of Computat.

Here it is to be noted, that when the Sign the Sun is in, is under 6, it is then North Declination if above South, and is therefore in the present Example South Declination, as being 9 Signs, the above Decimal being reduced, *&c.* gives 23° 27′, *&c.* and is nearly the Declination *per* Tables.

To obtain the Time of the Sun Rising and Setting, with the Length of the Day and Night.

With

With the Declination thus found, enter the Table titled ☉ Set. ☉ Rise, &c. and under the Latitude at the Head and Declination in the Margin, you have the Hour and Min. of ☉ Set. or ☉ Ris. accordingly.

In the present Example the Declination is 23° 27′ and in this Case may be taken for the greatest, *viz.* 23° ½, against which in the Margin of the aforesaid Table, and under the Lat. 51 ½, you have 8 h. 13′ in the Morning or after Midnight for the Time of Sun Rising, and is exactly the Time, for all other Latitudes in the said Table, entering with the proper Declinations, by proportioning, you will easily obtain the Sun's Rising, *&c.*

For the Length of the Day and Night.

In the present Example, the Time of the Sun Rising is 8 h. 13′ *viz.* 8 h. 13′ after Mid-night, consequently there will have been 8 h. 13′ before Mid-night for the other half of the Night, whence proceeds this Rule, *viz.* double Sun Rising it gives the Length of the Night and in this case is 16 h. 26′, which subtracted from 24, leaves 7 h. 34′ the Length of the Day, or if you subtract the Time of Sun Rising from 12 Hours, you will have the Time of Sun setting, which is plain, there being 12 Hours from Mid-Night to the Noon preceeding of every Day, and as in the above case there being 8 h. 13′ (the remaining part or half of the Night) from Mid-Night towards the Noon of the preceeding Day; by subtracting it, therefore, you

you will have $3^h\ 47'$ for the Time of Sun set-*i. e.* $3^h\ 47'$ after the Noon or middle of the preceeding Day, and consequently $3^h\ 47'$ can be but one half of the Day, from whence also comes the Rule of doubling the Hours, *&c.* of Sun setting for the Length of the Day, which will be found as above, and which taken from 24 Hours gives the Length of the Night as before.

For the Equation of Time.

The first Part of the Equation of Time is the Equation of the Sun's Centre reduced to Time, which Equation was found to be $778''$, and is reduced to Time thus, divide the same always by 100, *i. e.* pointing off two Places to the Right Hand, next divide them again by *9, the Quotient will be the Min. and Parts of Time required.

* Vid. Pag. 81.

Thus 7.78

.864
60

51.84
60

52.0

That is $51''\ 52'''$ or $52''$ Equation of Time answering to the Equation of the Sun's Centre as required, which must be applied to the apparent Time in the same Manner as before to the Mean Place of the Sun, *viz.* subtracted. The second Part of the Equation of Time depends

pends on the Sun's Place, with which enter the Table of that Title under that of the Sun's Declination taking out the Numbers accordingly. In the present Examples, the Sun's Place is $9^s\ 1^\circ\ 48'$ (in this case near enough) which being not to be found at the Head of the Table, it must, as before noted, be subtracted from 12, and the Remainder (or Complement) sought at the Head of the said Table, *viz.* $2^s\ 28^\circ\ 12'$, under 2^s at the Head, and 25° in the Margin the next less than the Deg. to be enter'd with, you have $1'\ 48''$ or $108''$, and against 3 Signs the next greater, (the Table serving to every 5 Deg.) it will become 0, whence it will be as (instead of dividing by 5, you may multiply by .2) 5 Deg. the Marginal diff. is to $108''$ so is $3^d.2$ the diff. between the Deg. to be enter'd with, and the next less to $69''$, which subtract from $108''$ as the same was decreasing, gives $39''$ the Equation of Time depending on the Sun's Place required, which Equation as the Complement to 12 Signs was made use of, must, contrary to the Title of the Table, be added to the apparent Time.

The first Part of the Equation was found to be $52''$ ablative, or to be subtracted, and the latter $39''$ to be added, their diff. therefore, *viz.* $13''$ is the true Equation of Time to be subtracted according to the Title of the greater Part, and is directly the same by the Tables.

For the right Ascension of any Point in the Ecliptic, let the right Ascension of that Point of the Ecliptic, the Sun is in, *viz.* $9^s\ 1^\circ\ 48'\ 6''$ be required.

But

Here it will be convenient to ſhew how to reduce Min. and Seconds of Time into Deg. and Min. of the Equator *, firſt divide the Seconds by 4, the Quote is the Min. and the Remainder ſo many Times 15″. Alſo divide Min. by 4, the Quote is Deg. and the Remainder ſo many times 15′; as ſuppoſe the greateſt Equation of Time in the Table depending on the Sun's Place, *viz.* 9′ 54″ be reqired to be reduc'd to Deg. and Min. of the Equator, firſt 54″ divided by 4, gives 13′ for the Quote, and 2 Remainder, which therefore gives 30″. Next 9′ divided by 4, gives 2° for the Quote, and 15′ for 1 the Remainder, ſo that the true Anſwer is 2° 28′ 30″; for a Proof hereof, let the ſaid 2° 28′ 30″ be reduced all to Seconds, which will be 8910″, the ſame being reduced to Time by the Method before in the Equation of the Sun's Centre, will be as follows, thus $\frac{8910}{9',96''}$ *i. e.* 9′ 54″ as at firſt. The ſame thing may be effected by multiplying 2° 28′ 30″ back again by 4, which corroborates the Work.

This being done, it is to be obſerved, that the right Aſcenſion of any Point of the Eclipic differs from the Longitude of the ſaid Point more or leſs by the Equation of Time reduced as before ſhewn depending on the Sun's Place, ſuppoſing him to poſſeſs the ſaid Point of the Ecliptic.

In the preſent Example of the Sun's Place, the Signs being reduced to Deg. the Point in the Ecliptic will then be 271° 48′ 6″ but the

 Equation

* If there be Thirds, divide them by 4, the Quote will be Seconds and the Remainder ſo many Times 15 Thirds.

Equation of Time before found, *viz.* 39″ is 9′ 45″ when reduced, and as the same was Additive, it must therefore be added to the above Point of the Ecliptic, which gives 271° 57′ 51″, the right Ascension required, and is exactly the same by the Tables.

To find the right Ascension in Time of any Point of the Ecliptic.

Let the right Ascension in Time of the aforesaid Place of the Sun, *viz.* 271′ 48′ 6″ be required.

Here it must likewise be observed, that every 15° of the Equator is equal to one Hour in Time, from whence it is plain that every Quadrant or 90° is equal to six Hours, and from whence also may easily be deduced this Rule, *viz.*

Divide the * Seconds by 15, the Quote is so many Seconds, and the Remainder so many times 4 Thirds; next divide the Min. by 15, the Quote is so many Min. and the Remainder so many times 4 Seconds. Lastly, divide the Deg. by 15, the Quote is so many Hours, and the Remainder so many times 4 Min.

According to this Rule in the above Example, *viz.* 271^s 48′ 6″. the 270° or 3 Quadrants, give 18 Hours, and 1° remaining. Next, the 6″ gives 24‴ and the 48′ gives 3′ 12″, and the 1° remaining 4′, amounting in all to 18^h 7″ 12′ 24‴, to which adding 39″ Equation of Time depending on the Sun's Place as the same was additive,

* If there be Thirds, divide by 15, the Quote will be Thirds, and the Remainder so many Times 4 Fourths.

additive, makes $18^h\ 7'\ 51''\ 24'''$ the true right Aſcenſion in Time required, or if $271^s\ 57'\ 51''$ the right Aſcenſion of the ſaid Point in the Ecliptic before found be by this Rule reduced to Time, it will be found the ſame: As it will alſo by the Tables.

Having thus diſpatched the principal Uſes of the Tables in the Chronologer relating to the Sun, I ſhall next proceed to the ſame for the Moon.

And firſt let her Place be required according to the Theory to the aforeſaid Time with that of the Sun, *viz.* *December* 12, 1738, at $5^h\ 27'$ P. M.

Mean Places in the Chronologer *Dec.* 1.

Me. Place	Apogé	Node
$0^s\ 16°\ 27'\ 48''$	$11^s\ 29°\ 53'\ 53''$	$5^s\ 22°\ 40'\ 12''$

Note, It will be convenient to regiſter the following Equations of the Moon, *&c.* found by the Chronologer in a Piece of Paper, as in *Page* 143.

Next the Mean Motion of the Moon for a single Year in the said Chronologer is .359401

Mult. by Years from Radix			2
☽ Me. Mo. *per Diem*		.036601	.718802
Days from *Dec.* 1.		11	
		426112	.402612
☽ Me. Mo. *per* H.	.001525		
Time from Noon	5.45	Dec. express'd	
	7625		
	6100		
	7625		
	† .00831125		.M ‖ .008311
			(1).129725

† Vide pag. 21.
‖ Vide pag. 98. 99.

Here the Sum Total of these Mean Motions amount to one Revolution, and so many decimal Parts of the Circle towards another, *viz.* the Decimals express how far the ☽ is from the Vernal Equinox, or first Point of *Aries*, which being all that is required, the Revolutions or Numb. of Times that the Moon has made the Circle, are omitted.

The Decimals may be reduced according to the Rule, *Page* 98, or thus:

The decimal Parts above are	.129725
Multiply by	6
	778350
Mult. this last Product again by	6
	4670100

Lastly,

Lastly, pointing off a Place less for Decimals than are the Number of those so multiplied gives the true Product in Deg. and decimal Parts of a Degree 46°.70100.

The Signs the said Numb. of Deg. at any time contain, are seen by Inspection, each Sign containing 30 Deg. and is here 1ˢ 16° the remaining Decimals being Parts of Deg. will be found *per* Rule, *Page* 96, to be 42′ 4″ *ferè*.

And thus there is found to be added to the Mean Place of the Moon on the first of *December* 1736, 1ˢ 16° 42′ 4″ which will reduce it to the time required, for the Year 1738.

Motions of the Apogé and Node for a single Year are

	Apogé
	.11295
Ye. a Rad. Mult.	2
Product	.22591
	6
	135546
	6
i. e. 2ˢ 21° 19′ 41″	81°.3280

	Node
	.05369
Ye. a Rad. Mult.	2
Product	.10738
	6
	64428
	6
	38°.6568 *i. e.* 1ˢ 8° 39′ 24″

Next the Mean Motions of the Apogè and Node for a Day being but small, it will be best to operate with them in Seconds

	Apogè	Node	
Mo. *per Diem*	401″	191″	Mo. *per Diem*
Days fr. *Dec.* 1.	11	11	
i. e. 1° 13′ 31″	4411″	2101″	*i. e.* 35′ 1″

Time from Noon further required decimally expreſs'd, $5^h.45$

Time à Noon	5. 45	5. 45	Time à N.
Mo. Ap. *per* h.	17″	8″	M. ☊ *vel* N.
i. e. 1′ 33″ *ferè*	92″.65	43″.60	*i. e.* 44″ *ferè*

Which being reſpectively collected together, make $2^s\ 22°\ 34'\ 45''$, to be added to the Mean Place of the Apogè, and $1^s\ 9°\ 15'\ 9''$ to be ſubtracted from that of the Node on the firſt of *December* 1736, which will alſo reduce them to thoſe for the Time required in the Year 1738.

Mean Places ☽, &c. on *December* 1, 1736, as before.

	☽ Mean Place				Apogè					Node			
	s	°	′	″	s	°	′	″		s	°	′	″
Dec. 1, 1736.	0	16	27	48	11	29	53	53		5	22	40	12
Reductions	+1	16	42	4	+2	22	34	45		—1	9	15	9
1738 *Dec.* 12, &c.	2	3	9	52	2	22	28	38		4	13	25	3

For

For the 1° Equations of ☽, Apo. and Node.

The Decimal Multiplicators in the Chronologer, which are according to Mr. *Machin's* Numbers, are fo little different from thofe of the Theory, that they might be ufed inftead thereof, being for the latter 1° Equat. ☽ .102, for the Apogè .172, and for the Node .082, which I fhall here make ufe of, the Place of the Moon being required according to the Theory.

Accordingly Multiply the Seconds of the Equation of the Sun's Centre for the Time propofed by the faid common Multiplicators, and you have the firft Equations in Seconds refpectively, which muft be added to the Mean Places of the Moon and Node, but fubtracted from that of the Apogè, when thofe for the Sun's Centre were fubtracted; and the contrary when thofe of the Sun's Centre were added.

In this Example, the Equation of the Sun's Centre was found 778″ to be fubtracted in order to give the true Place of the Sun, which place as follows

*—778″	—778″	—778″
.102	.172	.082
1556	1556	1556
778	13226	6224
‡+79″.356	*—133″.816	‡+63″.796
i. e. 1′.19″	*i. e.* 2′.14″	*i. e.* 1′.4″

Which

* This Sign or Character, as has been fhewn, fhews the Numb. immediately following to be fubtracted.

‡ And this to be added.

Which being applied refpectively to the aforefaid Mean Places, give thofe for the firft Time Equated as follows, *viz.*

☽ Me. Place	Apogè	Node
$2^s\ 3^\circ\ 11'\ 11''$	$2^s\ 22^\circ\ 26\ 24''$	$4^s\ 13^\circ\ 26\ 7''$

For Second Equation of ☽.

In the Table under that of the Sun's Declination on his Place, you have that of the fecond third Var. (*i.e.* Variation) fixth and feventh Equations of the Moon, where that for the faid fecond Equation is $214''$ next with the Sun's Mean Anomaly, which here may be taken $5^s\ 24^\circ$ enter the Table of the Increment to the Variation of the Moon, feeking the Sign or its Complement at the Head of the Table of the Equation of the Sun's Centre, which in this Example is 5 Signs, under which, and againft the Deg. in the Margin of the faid Increment Table, which is alfo here 24°, you have an Equation in Seconds, which in the Variation muft always be added thereto, but in this fecond Equation, only one tenth thereof, as expref's'd by the conftant Multiplier under the fecond Equation $214''$ before taken out from the Head of the Table, anfwering to the aforefaid $5^s\ 24^\circ$ the Sun's Mean Anomaly are $240''$, Increment one tenth of which, *viz.* $24''$ muft be added to $214''$, which makes $238''$; next fubtract the Place of the Apogè firft equated from that of the Sun before found, *viz.* $9^s\ 1^\circ\ 48'\ 6''$, and with the difference which in this Example will be found $6^s\ 9^\circ\ 21'\ 22''$ feeking the Sign or its Compliment at the Head of the Table under

declination

declination ☉ on his Place, which here is 6, and against the Deg. &c. (proportioned if required) in the Margin of the said Table for second third, &c. Equations, take out the Decimal answering thereto, by which multiplying the above 238″ gives the present Equation in Seconds required.

Under 6ˢ and against 8° in the Margin, is the Decimal .2756, and against 10° .342, the diff. is .0664, half of which the Marginal diff. being always 2° is .0332, which multiplied by 1. 36 the diff. between the lesser Marginal Deg. *viz.* 8° and that to be enter'd with as above, gives .0452 *ferè* to be added to the Decimal against 8° the said lesser Marginal Deg. *viz.* .2756, which makes

	.3206
Equat. as before found	238″
	25664
	9624
	6416
True second Equat. required	76″.3504, *i.e.* 1′ 16″

which as the Sign entered with, was immediately found at the Head of the Table and not its Complement, must therefore according to the Title, as express'd in the Margin, be subtracted from the Mean Place of the Moon first Equated, which gives her Place the second Time Equated, *viz.* 2ˢ 3° 9′ 55″.

For the third Equation of ☽.

At the Head of the Table (as before of the ſecond Equation) you have 47″ for the third Equation, next with the Diſtance of the Node, firſt Equated, from the Sun, *viz.* 4ˢ 18° 21′ 59″ (as before with that of the Apogè for the ſecond Equation) take out the Multiplier anſwering thereto, by which multiplying the ſaid 47″ gives the preſent third Equation requir'd.

As the ſaid Diſtance of the Node from the Sun cannot be found at the Head of the Table, therefore you muſt enter with its Complement, *viz.* 7ˢ 11°, *&c.* when the ſaid Multiplier will be found to exceed .99, which being ſo near Unity, it may be taken for it, by which the whole 47″ will be the Equation required to be added contrary to the Title of the Table as the Complement was made uſe of, which gives 2ˢ 3° 10′ 42″ for the Place of the Moon the third Time equated.

For the ſecond Equation of the ☽'s Apogè.

In the Table ſo titled, the Equations anſwering to every five Deg. are expreſs'd in Deg. and decimal Parts of a Deg. as comprehending more Matter in the Spaces confin'd to, and alſo more ready for Uſe.

Enter the ſame with the diſtance of the Apogè the firſt Time equated from the Sun (being the ſame with that for the ſecond Equation) when proportioning with the * Marginal diff. as

* Which being always 5, inſtead of dividing thereby, multiply by .2.

as in other Tables you will obtain the Equation, accordingly, which here will be found 3° 15′ 22″ to be added to the Place of the Apogè the first Time equated, which gives 2^s 25° 41′ 46″ for the true Place of the Apogè, which being subtracted from the Place of the Moon the third Time equated, gives the Moon's Mean Anomaly, and in this Example is 11^s 7° 28′ 56″.

For the Mean Elliptic Equation of ☽.

With the Mean Anomaly, or its Complement, enter the Table of the Mean Elliptic Equation of the ☽, and take out the Equation in like Manner, as in the other Tables, which will be found in this Example 2° 16′ 12″ to be added to the Place of the Moon the third Time equated, next to reduce this to the true, *Vide* the following Precepts.

For the present Eccentricity ☽.

Enter the Table of that Title with the distance of the Apogè first time equated from the Sun, and take it out in Manner as other Tables, which in this Example will be 6625.

Next for the Use of the Table of Reduction of the Mean to the true Elliptic Equation ☽.

Immediately under the Title, is to be understood the Anomalies of the ☽ to every ½ Sign or 15° for the first 6 Signs. Next under those respectively, and against 6678, which is the greatest

greateſt Eccentricity, are the Seconds to be added to the Mean Elliptic Equation, which gives the True.

At the Mean Excentricity, *viz.* 5505, the Mean Elliptic Equation is the True. Againſt the leaſt Eccentricity, *viz.* 4432, you have the Seconds alſo under each reſpective Anomaly to be ſubtracted from the Mean Elliptic Equation, which then gives the True.

Laſtly, the ſmall Numbers againſt the Mean Eccentricity, are for finding the Seconds which before was but to every $\frac{1}{2}$ Sign, or 15° to every 7° $\frac{1}{2}$ of Anomaly. Thus,

Add any two Numbers * of Seconds at $\frac{1}{2}$ Sign, or 15° of Anomaly diſtance together, next to half of this Sum, adding the ſmall Numbers directly between them, gives the Seconds required at 7° $\frac{1}{2}$, or Arithmetical Mean between the ſaid two Anomalies.

This being premis'd, I ſhall proceed to the Illuſtration thereof, in the preſent Example. In which the Anomaly (*viz.* its Complement as it exceeded 6 Signs) is $0^s\ 22°\ 31'\ 4''$, next as the preſent Eccentricity exceeds the Mean, the Seconds anſwering to the ſaid Anomaly againſt the greateſt Eccentricity muſt be ſought; but when the preſent Eccentricity is leſs than the Mean, than the Seconds againſt the leaſt Eccentricity anſwering to the then Anomaly muſt be ſought. The aforeſaid Anomaly, *viz.*

* Againſt the greateſt or leaſt Eccentricities 'tis the ſame thing.

viz. 0^s 22° 31′ 4″, being between ½ Sign, *viz.* 15°, and 1° or 30°, the Seconds respectively under them, *viz.* 1089 and 2126, being added together, make 3215, to half of which adding the 10 directly under and between them, makes 1617″, for the Equation to be added to the Mean Elliptic Equation, which gives the True at 22° ½, Mean Anomaly and the greatest Eccentricity 6678. But the present Anomaly exceeding * 22° ½, the Excess must be proportion'd for, thus: The Diff. between 1617″, and the next greater, *viz.* 2126 is here 509″, whence it will always be as 7° ½ (the constant Difference) is to the Difference of Seconds, thus found; so is the Excess of the present Anomaly above that before found in the Table (which is here also 1′ 4″) to the Seconds to be added to those also before found, against the greatest or least Eccentricity. The 7° ½ being always a constant Divisor, and as Multiplication is easier than Division, instead of dividing thereby, multiply by .13, gives the Answer required.

509

* Which in this Case might have been taken for it, but only to clear up future Operations.

509″
Dec. 1′ 4″ .017

3563†

3958
509

9.048
.13*

30163 *fe.*
9048

Answer 1″, 1.20651

† Vide pag. 81.

In the first Multiplier the 7, as it exceeds 5, might have been made 8; and in the 2d. 3, as under, might have been us'd only as a single 3.

* Vide pag. 68. Ex. 3.

which 1″ added to 1617″ makes 1618″ true Number of Seconds anſwering to the preſent Anomaly at the ſaid greateſt Eccentricity.

Next, to reduce theſe to the Number of Seconds anſwering to the preſent Eccentricity, as the ſame, *viz.* 6625, exceeds the Mean, 5505, ſubtract the ſaid Mean therefrom, the Dif. is 1120, in which Caſe it will always be as the Difference between the Mean and the greateſt Eccentricities, *viz.* 1173 (which is conſtant) is to the Number of Seconds before found againſt the greateſt Eccentricity (in this Example 1618) ſo is the Difference between the Mean and the preſent Eccentricity (which is here 1120) to the Seconds required.

1618

1618″
1120

19416
1618

1173) 1812160 (1545″ *fere.*
6391
5266 *i. e.* 25′ 45″
5740
1048

which 25′ 45″, as the prefent Eccentricity is greater than the Mean, being (as it muft always be in fuch Cafe) added to the Mean Elliptic Equation before found, *viz.* 2° 16′ 12″ gives 2° 41′ 57″ true Elliptic Equation, to be added to the Place of the Moon the third Time Equated, which gives her Place the fourth Time Equated, *viz.* 2^s 5° 52′ 39″.

When the prefent Eccentricity is lefs than the Mean you muft operate in all refpects as before, with the Seconds found in like manner againft the leaft Eccentricity and Difference between the prefent and Mean Eccentricities, &c. which then muft be fubtracted from the Mean Elliptical Equation, to give the True. *Vide* Page 24.

For the Variation of the ☽.

From the Place of the Moon the fourth Time Equated, fubtract the Place of the Sun, and with the Difference (or its Complement) which in this Example is 5^s 4° 4′ 33″, enter the Table

Table as before for the ſecond Equation, and take out the Multiplier anſwering thereto, which will be found .7867, next in the ſaid Table at the Head you find Var. N. *i. e.* the Variation according to Sir *Iſaac Newton*, to be 33′ 12″, then, with the Mean Anomaly, entering the Table of the Increment thereto, it will be found as before, with the ſecond Equation, to be 240″, or 4′, which added to 33′ 12″, as above, makes 37′ 12″.

Decimal Multiplier	.7867
Variation	37.2
	15734
	55069
	23601
i. e. 29′ 16″ *ferè*	29.26524

to be ſubtracted, contrary to the Title in the Margin, as the Complement was uſed, from the Place of the Moon the fourth Time Equated, which gives 2ˢ 5° 23′ 23″, the Place of the Moon the fifth Time Equated.

For the ſixth Equation of ☽.

From the Place of the Moon the fifth Time Equated ſubtract the Place of the Sun, which in this Example is 5ˢ 3° 35′ 17″, alſo from the true Place of the Moon's Apoge ſubtract the Place of the Sun's Apoge, which is alſo here 11ˢ 17° 24′ 16″. Add theſe two Remainders together, rejecting the Circle or twelve Signs, if they exceed it, next with half this Sum

Sum or Remainder above 12^s, or the Circle, which here is $2^s\ 10^\circ\ 30'\ 16''$, take out the Multiplier answering thereto, which will be

$$\begin{array}{r l} .6293 & \\ 145 & \text{Equ. à Table.} \\ \hline 31465 & \\ 88102 & \\ \hline {}^{*}\ 91.2485 & \textit{i. e. } 1'\ 31'' \end{array}$$

which $1'\ 31''$ being subtracted from the Place of the Moon the fifth Time Equated gives $2^s\ 5^\circ\ 21'\ 52''$ for the Place of the Moon the sixth Time Equated.

For the seventh Equation ☽.

From the Place of the Moon the sixth Time Equated subtract the Place of the Sun, which gives $5^s\ 3^\circ\ 33'\ 46''$, with the half of which taking out the Multiplier, as in the last Examples, it will be found .4451, by which multiplying $145''$, as serving indiscriminately for both Equations, you will have $1'\ 4''$, which Equation likewise follows the Rule of the last, which being therefore also subtracted from the Place of the Moon last Equated, gives $2^s\ 5^\circ\ 20'\ 48''$ for her Place the seventh Time Equated, which according to the Theory is her Place in her Orb.

* This Equation is to be subtracted when the Sign you enter with is under 3, but added when above.

For the true Place of the Node.

With the Diſtance of the Node firſt Equated from the Sun (as found for the third Equation) *viz.* $4^s\ 18^\circ\ 21'\ 59''$, enter the Table of the ſecond Equation thereof in manner as of that for the ſecond Equation of the Apogè, which for the ſame Reaſon is alſo expreſs'd in Deg. and decimal Parts, which ſaid Equation will be found by the Methods uſed in the other Tables to be $1^\circ\ 28'\ 32''$ to be ſubtracted from the Place of the Node firſt Time Equated, which gives $4^s\ 11^\circ\ 57'\ 35''$ for the true Place of the Node required.

For the Inclination of the Limit.

The Inclination of the Limit at 7^s is $13'$, and againſt 8. it is $4'$ the Diff. is $9'$; next, as the Deg. you entered with was 11.63, it will be as 30° or 1^s is to $9'$, ſo is 11.63 to $3'$ *ferè*, which ſubtracted from $13'$ under 7^s gives $10'$ for the preſent Inclination of the Limit.

Next, ſubtract the true Place of the Node from the Place of the Moon in her Orb, which Diſtance in this Example is $9^s\ 23^\circ\ 23'\ 13''$

For the Reduction and Exceſs.

With the Diſtance, or its Complement, of the Node à ☽ in her Orb, enter the reſpective Table, which Numbers are here in Minutes and Seconds, when the ſimple Equation anſwering thereto will be found $4'\ 45''$; next, for the Exceſs

Excess at the same Time, it will be as 30° or 1^{s} is to $42''$ (which it is found to decrease in the said 30°) so is the Deg. entered with above the said Sign to $8''$, to be sub. from $42''$, which gives $34''$, the Excess answering to the aforesaid simple Reduction, which Excess must again be reduc'd thus, as $18'$, the greatest Inclination of the Limit, are to $10'$, the present Inclination found as before, so is the Excess at first taken out, which here is $34''$ to $19''$ *ferè*, the present Excess to be added to the simple Reduction before found, which gives $5'\ 4''$, the present Reduction and Excess, which is to be added to the Place of the Moon in her Orb, which gives $2^{s}\ 5^{\circ}\ 25'\ 52''$ for her Place in the Ecliptic.

For the Latitude of the ☽.

With the aforefound Distance of the Node from the Moon in her Orb entering the respective Table, the simple Lat. will be found $4^{\circ}\ 34'\ 41''$; and here it is to be noted, that when you make use of the Complement in entering the Table, the Latitude will be directly opposite in Name to what you find at the Head of the Table, as in this Example it is found to be North ascending; but as the Complement was made use of, the Latitude will therefore be South descending, the Increment is thus found, the greatest is $18'$, but at the Head of the Table under 2^{s}, the Complement, &c. entered with, you will have $16'$, wherefore in 30° there will be but $2'$ Increase; so that it will be as 30° is to $2'$, so is the Deg. &c. entered with, *viz.* $6^{\circ}.61$ to $,44$ or $26''$ to be added to $16'$ at the Head of the Table, as before, whence

the preſent Tabular Increment will be 16′ 26″, which muſt be reduced as was the Exceſs, *viz.* as the greateſt Inclination of the Limit 18′ (or rather in this Caſe for the Lat. * 17′ 45″) is to the preſent taken out at the Equation of the Node, *viz.* 10′, ſo is 16′.44 to 9′.16″, the preſent Increment, which added to the ſimple Latitude before found, gives 4° 43′ 57″ for the true Latitude South deſcending of the ☽ required, and is within 7″ *per* the Tables.

And thus is the Place of the Moon, *&c.* ſtrictly computed according to the Theory from the *Chronologer*, when, if every reſpective Equation be taken from the Tables, and compared therewith, there will be found ſcarce any Difference, or at moſt none that is conſiderable.

The ſame might alſo have been done with three Equations only, as in *Page* 164, making uſe at the ſame Time of the Variation, *Va. M. i. e.* according to Mr. *Machin*; but the Theory containing more Operations, I judg'd, that an Example according thereto would be moſt conducive to the clearing up all Difficulties that may ariſe in theſe Calculi.

For the Right Aſcenſion of ☽.

Find the Right Aſcenſion of that Point of the Ecliptic ſhe is in, as before, of the Sun *(p. 313)* which will be found to be 63° 30′ 22″, and which in Time is 4^h 14′ 1″.

For

* Inſtead of dividing you may uſe the common Multiplier .0563.

For the Moon's Southing.

From the Right Aſcenſion of the † Moon in Time at Noon of that Day ſubtract that of the ‡ Sun, adding 24^h if Sub. cannot otherwiſe be made, the Remainder will be nearly the Time of the Moon's Southing, to which adding 2 min. and $\frac{1}{6}$ for every Hour of the ſaid Remainder, you will thereby obtain it ſtill more accurate.

	h.	′	″
Right Aſcen. ☽ in Time	4	2	57
Ditto ☉.	18	6	52
Rem. P. M.	9	56	5
For the Hours of the Remainder		21	30
Time of ☽'s Southing not regarding the Lat.	*10	17	35

Next, to equate for the Lat. it muſt be obſerved, that when the greateſt Latitude takes place, *viz.* about 5°, there will then be about 8′ of Time Difference of her Southing, found as above, which may be eſtimated in other Latitudes near enough by Proportion.

Then to find when it is to be added or ſubtracted, obſerve this Rule.

If the Moon's Place is between the firſt Deg. of ♋, *viz.* 3 Signs, and that of ♑, *viz.* 9 Signs, and her Lat. be North, you muſt then add the ſaid

† Whoſe true Place is then (*viz. Dec.* 12. 1738.) $2^s\ 2°\ 48'\ 6''$
‡ Ditto. 9 1 34 23

* When the Hours exceed 12, it is called ſo many Hours in the Morning, as is the Exceſs above 12.

said Min. to the Time of her Southing; but if her Lat. be South, you must then subtract them. Again, if her Place should be between the first Deg. of ♑, *viz.* as before, 9 Signs, and ♋, 3 Signs, and her Lat. South, you must then add the said Min. but if North, you must subtract them to and from the Time of her Southing, found as before.

In the present Example the Moon's Place, *viz.* 2^s, *&c.* is between 9 and 3, and her Lat. S. being also nearly at her greatest Lat. the $8'$ may be taken, the which, according to the Rule, being added to her Southing before found, gives $10^h\ 25'\ 35''$ for the true Time of Southing.

For the Declination of the ☽.

Find the Declination of that Point of the Ecliptic she will be in, * (as before of the Sun,) which in this Example will be found $21^{\circ}\ 35'$ *ferè*.

Next, for every Deg. of Latitude allow $5'$, which in this Example being nearly 5, will be about $25'$, for the ☽'s Lat. the Min. so found, always take place when the Moon, *&c.* is in the first Point of *Aries*, or 0 Signs, and decreases to 0, when she comes to the first Point of ♋, or 3 Signs, when it increases again in the same manner as it decreased (in both which it is nearly in Proportion) 'till it arrives to $25'$ again at the first Point of ♎, or 6 Signs, when it observes the same alternate Method with the other 6 Signs; if the Lat. had been but 3°, then there

* By adding to her Place at Noon $\frac{1}{2}$ Deg. for every Hour, *&c*, after her Southing.

there would have been but 15′ to have obſerved this Order, *&c.*

In this Example the Moon's Place being 2ˢ 8°, *&c.* falls within the firſt 3 Signs, and as the aforeſaid 25′ will vaniſh at the End of 3 Signs, at that rate it will loſe about 8′ at the End of every Sign, and conſequently 16′ at the End of 2 Signs, and as the Moon is about 8°, or a fourth Part of a Sign farther advanced, there will be a fourth Part of 8′ more decreaſed, *viz.* 2′, which added to the 16′, make 18, which being now ſubtracted from 25′, as above, leaves 7′, anſwering to the Place of the Moon, which muſt always be ſubtracted from her Latitude, and the Remainder, which in this Example is 4° 53′ 50″, to be applied as follows.

It has been before ſhewn, that the Points of the Ecliptic in the firſt 6 Signs are of North Declination, and thoſe of the latter South.

Therefore, when the Latitude of the Moon ſhall happen to be of the ſame Denomination, *viz.* North or South, with the Declination of the Point of the Ecliptic found as before. Then this Remainder muſt be added thereto, otherwiſe it muſt be ſubtracted, which gives the preſent Declination of the Moon required.

In this Example the Declination of the Point of the Ecliptic before found is.

	°	′	″
North	21	35	0
Rem. as above (Lat. ☽ being S.)	4	53	50
Remains ☽'s Declin. North	16	41	10

But

But, when the Lat. is greater than the Declination of the Point of the Ecliptic, the said Declination must be taken therefrom, when the Difference will be the Declination required of the same Denomination with the Lat.

For the Rising and Setting of the Moon.

From the Change to the Full it is called her Setting.

From the Full to the Change her Rising.

In the present Example, by subtracting the Sun's Place from the Moon, it will be found, as has been before, to be a little above 5^s distant from him; therefore as she is not come to the Opposition or Full, it will be her Setting to be sought for.

In order to which, with her Declination just found, enter the Table of the Rising and Setting of the Sun, as if it was the Sun's Declination, (which in that Case would be the Time of his Setting) and take out the Setting of the Sun answering thereto, *viz.* $7^h\ 29'$, to which add the Time of the Moon's Southing, and so many times $2'\ \frac{1}{6}$ as are the Hours of the Moon's Southing after Noon, and you have the Time of the Moon's Setting required.

Time

	h.	′	″
Time of the Sun's Setting with the Decl. aforesaid	7	24	
Time of Moon's Southing †	10	24	47
Equation for ditto		21	42
Time of the Moon's Setting in the Morning required	6	10	29

The Time of the Moon's Southing, with the Equation, is the Time of her Continuance above the Horizon after Sun-set, and in this Example 10 h. 46′ 29″.

For the Moon's Rising.

Here it is to be observed, that in this Case the Moon's Southing will always be found 12^h or more after the Sun, which subtract from 24^h the Remainder will be the Time she souths before the Sun of the succeeding Day.

Next, as before of the Setting, you must now with the Declination of that Point of the Ecliptic the Moon is in at her Southing, find what Time the Sun would rise there with, from * which subtract the Time of the Moon's Southing before the Sun, found as above, which gives nearly the Time of her Rising; but to be still more accurate, subtract the same from the Time of the Moon's Southing first found after the Sun; when deducting therefrom so many times $2' \frac{1}{12}$ as are the Hours, &c. of this last Difference, gives the true Time of her Rising required.

* First adding 12 ho. if requisite.

And here it is to be noted, that when the Time of the Moon's Southing before the Sun

Xx is

† In the last Example 2 min. one sixth was used, which should be but 2 min. one twelfth, when it will be as above.

is greater than that of the Sun's Riſing, found as before, the Moon's Riſing is then ſaid to be at ſuch a Time after Noon of the ſame Day; but when leſs, at ſuch a Time of the ſucceeding Morning.

Example.

Let the Moon's Riſing be required *Dec.* 18. 1738. at which Time at Noon the ☉'s Place ♑ 7° 41′, and the Moon's ♌ 14° 15′, *viz.* 9^s 7° 41′ and 4^s 14° 15′

	h.	′	″
* ☽ Right Aſcen. in Time	9	6	56
☉ ditto	18	33	33
	14	33	23
Equation for Hours, *&c.*		30	25
True Time of Southing	15	3	48
Compl. to 24^h ☽'s So. before ☉	8	56	12
☉ Riſe in 14° ♌ ☽'s Place above	4	30	0
☽ So. bef. ☉ à ☉ Riſe (+12 ho.)	7	33	48
For $7^h \frac{1}{2}$ diff. à true Time ☽'s Southing ſubtr. *ferè*		15	38
True Time of ☽'s Riſ. Aftern.	7	18	10

The Difference of the true † Times of the Moon's Riſing and Southing doubled, with ſo many times 2′ $\frac{1}{12}$ as are the Hours of the ſaid Difference, gives the Time of her Continuance above the Horizon.

Having thus (as before of the Sun) gone thro' the Tables of the Chronologer with reſpect to the

* At which Time ſhe has no conſiderable Latitude.

† 15 h. 3 min. 48 ſec. leſs 7 h. 18 min. 10 ſec. doubled gives 15 h. 31 min. 16 ſec. to which adding 16 min. 10 ſec. for the Difference, gives 15 h. 47 min. 26 ſec. for the Time above the Horizon.

When the ſaid Double exceeds 24 h. ſubtract 24 h. therefrom, the Remainder is the Anſwer.

the Moon, I ſhall next proceed to its Uſe in diſcovering of Eclipſes for any Time paſt or to come.

And firſt Hiſtory makes mention of a total Eclipſe of the Sun predicted by *Thales*, 585 Years before Chriſt, by which Eclipſe a memorable Battle between the *Medes* and *Lydians* was put an end to, and Peace enſued thereon.

From the Birth of Chriſt to the Radical Year 1736, are

Compleat Years	1735
Years before Chriſt	585
	†4)2320(580

† *Vide* p. 113.

☉ 4 Year.	☽'s 4 Year. Cir.	☊ 4 Year. Cir.
°		
.030356	.4742*	.21491
580	580	580
242848	37936	171928
151780	23710	107455
	Rev. 275)036—	Rev. 124)6478+
*17°.60648	6	6
60	216	38868
	6	6
36'.3888	12°.96	233°.208
60	60	60
23''.328	57'.6	12'.48
	60	60
	36''	28.8

X x 2 Next,

* Which will always be found ſufficient.

Next, to eftimate the Time of the Year an Eclipfe fhall happen, we muft, as has been already fhewn, always have regard to the Place of the Node; accordingly in this Example there has been found $7^s\ 23°$, *&c.* to be added (as going back) to the Mean Place of the Node on the Firft of any of the Months in the Radical Year 1736, to reduce it to that for the Time here gone back to, when it will be beft to begin with the Month of *January*, on which the Radical Mean Place thereof is $6^s\ 10°$, *&c.* to which adding $7^s\ 23°$, gives $2^s\ 3°$, *viz.* ♊ for its Place, which Sign the Sun does not enter till *May*, which is the Month we muft now direct our Courfe to. Accordingly the Mean Places of the ☉, ☽, and ☊, on the Firft of the faid Month in the Radical Year 1736, are as follow,

	☉ s	°	′	″	☽ s	°	′	″	☊ s	°	′	″
May 1. 1736	1	20	30	4	—2	16	42	53	—6	4	0	9
2320 Ye. back	—	17	36	23	—	12	57	36	+7	23	12	29
Mean Places	1	2	53	41	2	3	45	17	1	27	12	38

Here the Sun is above 24 Deg. diftant from the Node, and confequently could fuffer no Eclipfe the preceding Part of the Year.

It may alfo be obferved, that the Moon is juft paft the Conjunction, wanting nearly 11 Signs of the next, which reduced to Deg. and the fame divided by 12, will give the Day of the next Conjunction, *viz.* 329, divided by 12, gives a little more than 27 Days, which added to the firft Day of the Month, gives the 28th

for

for the Change, at which Time the Sun will be about 27° farther, and also within 3° or 4° of the Node, allowing it to go back a Degree, and * consequently will then suffer an Eclipse, and is the same Day of the Month mention'd by Sir *Isaac Newton* in his Chronology. If it be required what Day of our Week this answers to, the Cycle of the Sun must first be found, which for any Time back will be as follows.

* *Vide* pag. 293.

Subtract *9 from the Number of Years before Christ, divide the Remainder by 28, lastly subtract the Remainder, if any (if none, 28 is the Cycle) from 28, this last Remainder will be the Cycle required, which in this Example will be found to be 12, and the Dominical Letter G; whence the first Day of *May* fell on *Tuesday*, and consequently the 28th, whereon this Eclipse happened, on a *Monday*, in the 585th Year before Christ.

In the same Manner with the proper Numbers may the Prime be found for any Time back, *viz.* by subtracting 1, and dividing by 19, &c.

Josephus writes, that an Eclipse of the Moon preceded a little the Death of *Herod* the Great, in whose Time our Saviour was born, which the learned *Nicholas Man*, Esq; present Master of the *Charter-House*, writes in his Chronology, was computed by *Kepler*, as it is also by Mr. *Whiston* in his Astronomy, to have happen'd in the 4th Year before our Common Æra of the Birth of Christ.

Compleat

* When the Number of Years back exceed 9, otherwise they must be subtracted from 9, the Remainder is the *Cycle*.

Comp. Ye. from Chriſt's Birth 1735 as before.
Before ditto 4

4)1739(434
(3)

Which prepared will be * 435 Years to go back, and 1 ſingle Year forward therefrom.

* *Vide* pag. 113, 114.

☉	☽	☊
.030356	.4742	.21491
435	435	435
151780	23710	107455
91068	14226	64473
121424	18968	85964
13°.204860−	206).2770−	93).48585+
60	Sin. Year .3594+	Si. Ye. .05369−
12′.2916	.0824+	.43216+
60	6	6
17″.496	4944	259296
	6	6
	29°.664	155°.5776
	60	60
	39′.84	34′.656
	60	60
−13° 12′ 17″		
Sin. Ye. 14 20	50′.4	39″.36
−13° 26′ 37″	$+0^s 29° 39′ 50″$	$+5^s 5° 34′ 36″$

By adding theſe Numbers of the Node thus found to thoſe in the Radix on the Firſt of *January*, it will be found, that the Sun will not

not be there till about the latter End of *February*, or Beginning of *March*, the Mean Places on the First of *March*; therefore are as follow.

	☉				☽				☊			
	s	°	′	″	s	°	′	″	s	°	′	″
Radix	11	20	22	36	11	22	57	17	6	7	13	48
	—	13	26	37	+	29	39	50	+5	5	34	39
4th Ye. bef. Xt.	11	6	55	59	0	22	37	7	11	12	48	27

Here the Sun is (according to their Mean Places) about 5° from the Node of the Moon, and subtracting the Sun's Place from her's she will be found to be about 45° Distant, which divided by 12, gives nearly 4 for the Number of Days since the Conjunction, for which deducting about 4 Deg. from the Sun's Place, he will still be but about 9 Deg. from the Node, and consequently there was then an Eclipse of the Sun, *viz. Saturday* the 26th of *February* being Leap-Year, and the *Cycle* * ☉ 5.

Next, by adding 6 Signs to the Place of the Sun, you will have the Opposite thereto, *viz.* $5^s\ 7^\circ$, from which subtracting that of the Moon, *viz.* $0^s\ 22^\circ$, the Difference $4^s\ 15^\circ$ will be what she wants of the said Opposition, which being reduced to Deg. and divided by 12, as before, gives above 11 Days for the Time of the Opposition, for which adding 11 Deg. to the Place of the Sun, he will still be within 6 Deg. of the Node, and consequently there was then an Eclipse of the Moon, *viz.* on the 12th Day of *March*, &c.

Having

* The *Cycle* of the Sun being 9, the Year of the Birth of Christ, by subtracting 4 the Number of Years before therefrom, leaves 5, the *Cycle* of the Sun required.

Having found the Day that there will be an Eclipſe, in order to compute the Time nearly accurate, you muſt find the true Place of the Sun, next that of the Moon's Apogè in ſame manner as that of the Mean Place and Node, from whence you may eaſily obtain the Moon's Anomaly, as alſo the Elliptic Equation, by which you cannot fail of eſtimating the Time to a very ſmall Matter (*vid.* p. 297, 298, 299.) and here is found to be * 15 h. *&c.* P. M. of the ſaid Day, agreeing with the Time computed by Mr. *Whiſton*, the latter End of his Aſtronomy, by which it is evident, that the vulgar Æra of Chriſt is at leaſt 4 Years too late.

The true Year of the Birth of Chriſt, the aforeſaid *Nicholas Man*, Eſq; in his Book of Chronology, has prov'd to be juſt Six Years before the ſaid vulgar Æra.

* *Monday, March* 13. at 3 o'Clock in the Morning.

NECES-

Necessary Problems *ſolved by the Help of the* Chronologer.

PROB. I.

ANY Year, Month, and Day being given, to find the Day of the Week.

Find the Cycle of ☉ by Rules before given, and the Dominical Letter, whence the Week-Day of the Firſt Day of any Month will, as before ſhewn, be eaſily obtained, and by the continual Addition of 7, you will have the 8th, 15th, 22d, and 29th of the ſaid Month of the ſame Day of the Week alſo, and from thence what Day of the Week any other Day of the ſaid Month is.

Example.

What Day of the Week was the * 12th of *March* in the 4th Year before Chriſt, the Day whereon the Eclipſe of the Moon before computed happened.

The ſuppoſed Year that Chriſt was born the Cycle of the Sun was 9, from which deducting 4, there will remain 5 for the * Cycle of the Sun, the Dominical Letters anſwering

* *Vide* p. 343.

thereto in the Chronologer are B A, therefore it was Leap-Year, which last, *viz.* A, must be used as the Day required is after the 24th of *February*, whence counting from A as *Sunday*, the Months under B begin on a *Monday*, under C *Tuesday*, and under D, where *March* is, on a *Wednesday*; wherefore the 8th will be on a *Wednesday*, and consequently the 12th on a *Sunday*, as required. B, the first of the Dominical Letters is to be thus used, *viz.* to the 24th of *February*, 'till which Time the Place B possesses must be called *Sunday*; consequently *January* will begin on a *Saturday*, and *February* on a *Tuesday*, the other Days thereof follow the Rule.

The Converse of this, *viz.* having the Year, Month, and Day of the Week, to find the Day of the Month, can no otherwise be solv'd than by giving so many Days of the said Month as the said Day of the Week can happen on, when there will still be required to know whether it was the first, second, third, or fourth Week of that Month in order to be certain, unless it be attended with some other Circumstance, as being in *Easter*, *Whitsuntide*, or some other remarkable Day, *&c.*

PROB. II.

To find the *Foreign* or *Gregorian Dominical Letter*.

First, find the *Julian*, or ours, the third preceding exclusive thereof is the *Foreign Dominical Letter* required. The Reason hereof is, if from

from the *Julian Dominical Letter* exclusive, among the seven under those, containing the *Cycles*, &c. you count eleven to the Right-hand, the Number of Days they are before us, it will terminate the third preceding as before, when they come to be 12 Days before us, it will then be the second fourth, &c. which *Dominical Letter* is to be used in their Account as the *Julian* in ours.

Example.

* In the Year 1739. the *Gregorian Dominical Letter* is D, whence their First of *February*, *March*, and *November*, fall on a *Sunday*, from each of which subtracting 11 Days, gives *January* 21, *February* 18, and *October* 21, answering thereto in our Account, and are also *Sundays* with us, the Days of the Week in the other Months follow the Rule.

PROB. III.

Having given the Day of the Month *Easter* at any Time falls on, to find what Years of our Lord it shall happen on the same Day of the Month for ever.

Let the 25th of *March* be the Day of the Month required, which, according to the old Proverb, is, when *my Lord falls in my Lady's Lap.*

Here it may very easily be computed, that if the 25th of *March* is on a *Sunday*, the 22d will be

* The Year 1740 being Leap-Year, F E are the *Julian Dominical Letters*, the Third exclusive preeeding F is C, and the Third preceding E is B, whence the *Gregorian Dominical Letters* are C B.

be on a *Thursday*, and so of consequence will be also the First; next seek *March* under the *Dominical Letters* which you will find under D, call that *Thursday*; then count on to the Right calling the next, *viz.* E, *Friday*, F, *Saturday*, G, *Sunday*, whence it will be found that the 25th of *March* can never happen on a *Sunday* but when the *Dominical Letter* is G.

Then find among the *Cycles* and *Dominical Letters* how often you can find G there, which in Leap-year must be the last Letter, as being for the Month of *March*, taking out the several *Cycles* of ☉ against it, which will be found to be 6, 12, 17, 23.

Lastly, in the Table of finding *Easter* for ever, seek the *Dominical Letter* G, it being proved, that *Easter* (or any) *Sunday* can never happen on the 25th of *March* but then, under which you will find, that this will always happen when the Prime is either 5, 13, or 16, and not else; therefore, when the Prime is 5, *Easter* will happen, if the *Cycle* of the Sun be either 6, 12, 17, 23, *viz.* four Times with the Prime 5, and with the three Primes three times four, in all 12 Times; but the aforesaid *Cycles* of the Sun can so happen but once in 28 Years, and the Primes but once in 19 Years, wherefore the whole 12 Times can so happen but in 19 Times 28 Years, *viz.* 532, which is the *Dionysian* Period, after which all the Moveable Feasts begin again, observing the same Order in every subsequent as in the preceding Period.

PROB.

PROB. IV.

To find the Years of our Lord in the *Dionysian* Period, answering to the preceding Data, and consequently in all other.

Here it must be observed, that the Year of the Birth of Christ, the *Cycle* of the Sun was 9, and the *Prime* 1. whence follows the Rule, *viz.*

Add 9 to the Year of our Lord, and divide by 28, the Remainder will be the *Cycle* of the Sun.

Also add 1 to the Year of our Lord, and divide by 19, the Remainder will be the *Prime*.

Whence the Problem is reduced to this, *viz.* what Number is that to which if 9 be added, and the Sum divided by 28, the Remainder shall be any of the aforesaid *Cycles* of the Sun, suppose 12.

Likewise if to the same Number 1 be added, and the Sum divided by 19, the Remainder shall also be any one of the *Primes*, suppose 13.

By the last Condition of this Problem 'tis plain, that if nothing be added to the Number required, and the same be divided by 19, that 12 will be the Remainder.

And

And as to the former, that if nothing be added to the ſame Number, 3 will then be the Remainder.

Firſt, let the Quotient, when the ſame is divided by 19, be called a, and, when divided by 28, b.

Then 19 times a, with 12 the Remainder added thereto, will be equal to 28 times b, with 3 added to it, *viz.* $19a+12=28b+3$, which reduced will be $19a=28b-9$.

And here $28b-9$ muſt needs be (by Conditions of the Queſtion) a Multiple of a; but if from a Multiple of ſome Number there be taken another Multiple of the ſame Number, the Remainder ſhall be alſo a Multiple of the ſaid Number, or Nothing. *Euc.* 7 *lib. Prop.* V.

Wherefore let a here be ſuppoſed 1, or Unity, then $19a$, *viz.* 19 being ſubtracted from 28 times $b-9$, leaves 9 times $b-9$, which will alſo be a Multiple of 19 from above.

Thus	$28b-9$
Subtr.	19
	$9b-9$

Here, as this laſt Remainder is a Multiple of 19, ſo it conſequently will be diviſible thereby.

Next,

Next, as the Remainder is reduced to such small Terms, it will be seen as it were by Inspection.

Whether if any of the nine Digits be taken for *b*, by which multiplying 9, the Co-efficient, and 9 taken from this Product, the Remainder shall be divisible by 19, which Digit will be the Value of *b* required.

So here, first supposing 1 for the Value of *b*, then 9 times 1 is 9, and 9 taken therefrom, 0 remains, and consequently 0 will be the Quotient when divided by 19; wherefore *b* is equal to 1; and 28 times *b* more 3, as at first (*viz.* 31) will be the Number answering both Conditions of the Problem, *viz.* which divided by 19, leaves 12, and also divided by 28, shall leave 3.

PROB. V.

Required the Year when the *Prime* is 5, and the *Cycle* of the Sun 6?

Here it is also plain, *viz.* instead of 1 being added to the Number required, and 5 to remain, when divided by 19, that if nothing be added, 4 will remain to answer the first Condition of the Question.

The last Condition is, that when 9 is added, and the said Number divided by 28, 6 shall remain, from whence it may be seen, that if the Difference, *viz.* 3, be taken from the Num-

ber to which 9 was to be added, the ſame will be 3 leſs than it was, and at the ſame time if 9 be added, it will then be 6 more; and conſequently, when divided by 28, 6 will remain, which gives the Rule, *viz.* When any Number is to be divided by a given Number, to which a certain Number is firſt to be added, and at the ſame Time there be required a Remainder leſs than the ſaid Number to be added, their Difference ſubtracted from the Number ſo to be divided, gives a Remainder which anſwers the Condition of the Queſtion.

Accordingly the preſent Problem will ſtand as follows.

$$19a+4=28b-3$$
$$19a=28b-7$$
$$\frac{19}{9b-7}$$

Herefrom the laſt Problem, b will be eaſily found to be 5, and conſequently 28 times b leſs 3 as at firſt equal to 137 is the Number required, which will be found to anſwer the Conditions of the Problem.

In purſuing the Solutions according to the firſt Data, it will be beſt to begin with the firſt *Prime*, going thro' all the *Cycles* of ☉, the like with the next, and ſo on to the laſt. By which Method all the Anſwers, when rang'd in Order, will be found as follow.

Year

$532 \times 3 = 1596$

Years of Christ 1st Period of 532,	*Years of Christ 3d Period.* &c.
31	1627
42	1638
53	1649
126	1722
137	1733
148	1744
221	1817
232	1828
316	1912
395	1991
479	2075
490	2086

In this Example I have taken the Multiple of 532, *viz.* 1596 to add to the Numbers in the first Period, (as being the nearest to this Century) by which you have the Years of our Lord from 1627 to 2086 both inclusive, and proceeding in this Manner with the next Multiple of 532, *&c.* they may be found *ad infinitum.*

By the like Method as the above Numbers have been computed, may those for finding *Easter*'s happening on any other Day of the Month whatever, within the Limits.

PROB. VI.

What Year of the *Dionysian* Period was it when Christ was born, the *Prime* being 1, and the *Cycle* of ☉ 9?

 Here

Here in this Caſe, as there is no Addition required, the Problem is, what Number is that which divided by 19, ſhall leave 1, and by 28, ſhall leave 9.

Which by the aforeſaid Rules will be found as follows.

$$19a + 1 = 28b + 9$$
$$19a = 28b + 8$$
$$\underline{19}$$
$$9b + 8$$

Here, as none of the nine Digits can be found equal to *b*, the Proceſs muſt be carried on a Step forwarder upon this Conſideration, *viz.* as the Remainder $9b + 8$ is a Multiple of 19 (ſuppoſing $a = 1$ as before) therefore of conſequence it will be diviſible thereby.

Next, let the Quotient, when ſo divided, be called *d*, and as the Quotient multiplied by the Diviſor is ever equal to the Dividend, $9b + 8 = 19d$, and

$$9b = 19d - 8$$

Suppoſing $b = 2$ ſub. $\underline{18 \quad - 0}$

Remainder will be $1d - 8$ a Multiple of 9 or 0.

From whence 'tis plain, that the Digit 8 will be the leaſt Value of * *d*; wherefore 19 times *d* leſs 8 will be found to be 144, to which 9 times

* Taking $1d - 8$ equal 0.

times *b* was equal, and conſequently *b* will be equal to one Ninth thereof, *viz.* 16, whence 28 times *b* more 9 (as at firſt) will be 457, the Year of the *Dionyſian* Period required, which, taken from 532, the Remainder 75 is what was wanting to compleat the ſaid Period at the Birth of our Saviour.

This laſt Operation, with the preceding, being truly digeſted, no Difficulties can ariſe in Problems of this Nature.

Beſides theſe two *Cycles*, there is another of 15 Years, called the *Roman Indiction*, which at the † vulgar Æra of the Birth of Chriſt, accompting in a retrograde Order from its Inſtitution, will in that Caſe be found to be * 3; wherefore, if to the Year of our Lord 3 be added, and this Sum divided by 15, the Remainder will be the *Indiction* required.

The Product made by the Multiplication of theſe three *Cycles*, *viz.* 19 into 28, into 15, is 7980, and is called the *Julian Period*, at the Expiration of which Number of Years all the three *Cycles* begin again, as at firſt, and all the *Feaſts*, &c. depending thereon, proceed in the ſame Order alſo as when they firſt began.

The Number of each *Cycle* for any Time being given, it will be eaſy purſuing the aforeſaid Method, to determine what Year of the *Julian Period*, as alſo what Year of our Lord the ſame is.

Zz 2 PROB.

† Which all theſe *Problems* reſpect.
* For any Time farther back proceed in manner as for the other Cycles.

PROB. VII.

At the Birth of Christ the *Prime*, as before, being 1, the *Cycle* of the Sun 9, and that of the *Roman Indiction* 3. *Quere*, What Year of the *Julian Period* was it?

The Import of this *Problem* is to find a Number, when divided by 19, leaves 1, by 28, leaves 9, (which by *Problem* VI. was found † 457) and divided by 15, shall have 3.

Here, as 19 and 28 are *Primes* to each other, their Product, *viz.* 532, will be the least common * Multiple to them, to which, or any Multiple thereof, if ‡ 457 be added, the said Sum will still have the same Property, *viz.* when divided by 19, to leave 1, and by 28, to leave 9.

Next, let the Number of Times that 532 is to be taken be called a, then $532a+457$ will, as before, still retain the aforesaid Property; the next Condition of the *Problem* is, that when this last Sum shall be divided by 15, the Remainder shall be 3.

Lastly, let the Quotient, when divided by 15, be called b; then (as before) will $15b+3$ be equal to $532a+457$, from each of which Factors, after Reduction, take the greatest Multiple of 15, possible when in the first Factor b will be found 35, and in the latter 30, multiplying each of which by 15, and their Products respectively subtracted, the Remainder will still be

† Year of the *Dionysian* Period answering the above Data.
* *Vide* Page 53. Ex. III.
‡ *Vide* Prob. VI.

be diviſible by 15, when, proceeding as in the preceding *Problems*, you will have the Number ſought, as follows.

$$15b+3=532a+457$$
$$15b=532a+454$$
$$\text{Sub.}\ ^{*}525\ +450$$
$$\text{Rem.}\ 7a+4$$

Here *a* may eaſily be diſcovered to be 8, whence 532 into 8 more 457 equal to 4713, is the Year of the *Julian Period* required, by which having the Year of our Lord, as alſo any Number of Years before Chriſt, what Year of the *Julian Period* the ſame is may be eaſily found.

PROB. VIII.

When the *Prime* is 8, the *Cycle* of the Sun 9, and the *Indiction* 14, what Year of our Lord is it?

Here the Import of the *Problem* is for the *Prime*, to find a Number to which if 1 be added, and the Sum divided by 19, 8 ſhall remain, therefore, when nothing is added, conſequently 7 will remain; next as 9 is always to be added to the Year of our Lord, and the Sum being divided by 28, the Remainder gives the *Cycle* ☉; ſo here, as 9 is to be the Remainder or *Cycle*, therefore there is no Occaſion for the Addition of 9 at all, whence it will be, taking for the Quotients *a* in the firſt Caſe, and *b* in the ſecond.

$$19a+7=28b$$
$$19a=28b-7$$
$$\text{Sub.}\ 19$$
$$\text{Rem.}\ 9b-7$$

Whence

* *b* in the firſt Factor is taken equal to 35, and in the latter 30.

Whence b may easily be discovered to be 5, and consequently 140 the Number answering the first Conditions of the Question.

Next, as in the *Indiction*, there is required 3 to be added to the Year of our Lord, and, when divided by 15, the Remainder will be the said *Indiction*; therefore the present *Indiction* being 14, if the Number, without the said Addition of 3, be divided by 15, there is required 11 only to remain; wherefore,*

$$\begin{aligned} 15b + 11 &= 532a + 140 \\ 15b &= 532a + 129 \\ &\ 525 \ \ + 120 \\ &\ \ \ 7a + 9 \end{aligned}$$

Here a also, as it were by Inspection, is found to be 3, and 532 into 3, more 140, equal to 1736, the Year of our Lord required.

Having, from Page 49 to 57 inclusive, treated of Multiples, &c. I shall instance the two following *Problems* on that Head.

PROB. IX.

Let it be required to find a Number, when divided by 2, by 3, by 4, by 5, and by 6, Unity shall remain; but, when divided by 7, there shall be no Remainder.

The least common Multiple to 2, 3, 4, 5, 6, will be found to be 60, to which, if Unity be now added, and the Sum be divisible by 7, the *Problem*

* Assuming a and b for the Quotients, as in *Prob.* VII and VIII.

Problem will be anſwered; but, ſeeing it is not, ſome Multiple of 60 muſt be ſought, to which, if Unity be added, the ſame ſhall be diviſible by 7.

Wherefore, as by the former *Problems*, it will be

$60a + 1$ to be diviſible by 7.
56
$4a + 1$ alſo diviſible by 7.

Whence a will be 5, and 301 the Number required.

To which, if there be now added 420, the leaſt common Multiple to 2, 3, 4, 5, 6, and 7, and ſo on, continually you will have Anſwers *ad infinitum*.

PROB. X.

Let a, Number be required, when divided by 2, Unity ſhall remain, by 3, 2 ſhall remain, by 4, 3 ſhall remain, by 5, 4 ſhall remain, by 6, 5 ſhall remain, and when divided by 7, nothing ſhall remain.

Here 5 is eaſily diſcovered to be the Number, when divided by 2 and 3, to anſwer ſo far the Conditions of the *Problem*.

Next, the leaſt common Multiple to 2 and 3, is 6, wherefore

$\dagger\ 6a + 5 = 4b + 3$ and
$* 4b = * 6a + 2$ where a, by Inspection, is Unity, consequently 11 answers the first three Conditions.

Next, the least common Multiple to 2, 3, and 4, is 12.

Therefore $\ddagger\ 12a + 11 = 5b + 4$ and

$$5b = 12a + 7$$
$$10 \quad -5$$
$$2a + 2$$ is divisible by 5, wherefore a is 4, and $12a$ more 11, equal to 59, answers the first four Conditions.

The least common Multiple to 2, 3, 4, and 5, is 60.

Whence $60a + 59 = 6b + 5$
And $6b = 60a + 54$

Here $\|\ 60a + 54$ is already a Multiple of $\|\ 6$, and consequently, supposing a equal to 1, 119 answers the first five Conditions of the *Problem*, and which, as is obvious, is also a Multiple of 7, and consequently answers all the Conditions required, thereby saving the carrying on of the Process any farther.

† Vide *Prob.* VII.
* When the Numbers are composed to one another, as here, *viz.* $4b$ and $6a$, in such case their greatest Common Measure, or Unity, will always be the least Value required, as above; otherwise the Question will be impossible.
‡ Vide last *Case* and *Problem* VII.
‖ In this last Step $60a$ is found to be a Multiple of $6b$, in such Case Unity will always be the least Value of a, &c. required; when, if the absolute Number should not be also a Multiple thereof, the Question will be impossible.

To obtain the Years of the *Julian* and *Dionysian* Periods for any Number of Years before and after Christ.

The Year of the *Julian* Period at the Birth of Christ being found, as before, to be 4713, (*p.* 357.) if the Number of Years since our Saviour be added thereto, and the Number of Years before subtracted therefrom, you will have the Year of the *Julian* Period at that Time.

Also as the Year of the *Dionysian* Period was found to be 457, (*p.* 355.) by subtracting the Number of Years before Christ, when under 457, therefrom, the Remainder will be the Year of the said Period required; but if the Number of Years before Christ should be greater than 457, subtract 457 therefrom, and divide the Remainder (if capable) by 532, the Number of Years in the said Period: this last Remainder, if any (otherwise 532 is the Answer) being subtracted from 532, gives the Year of the Period required; if the Remainder to be divided by 532, be less than 532, subtract it therefrom, which Remainder will then be the Year of the Period required.

If the Year of the said Period be sought at any Time after the Birth of Christ, instead of adding 457, and proceeding in manner as with the Cycle of the Sun, *&c.* as there then wanted but 75 Years to compleat the said Period, should the Number of Years after Christ be under 75, subtract them therefrom, the Re-

 mainder

mainder will be the Number of Years ſtill wanting to compleat the ſame, which ſubtracted from 532, gives the Year of the Period required; but when the Number of Years are greater than 75, ſubtract 75 therefrom, the Remainder, if under 532, is the Year of the Cycle; but if the ſaid Remainder be greater than 532, divide it thereby, and this laſt Remainder, if any, (otherwiſe, as before, 532 is the Anſwer) will be the Number of the ſaid Cycle required.

Let the Year of the ſaid Period be ſought at that of our Lord 1736, the Cycle of the Sun at the ſame time being 9, and the Prime 8.

1736 Year of Chriſt
75 Subt.

532) 1661 (3
65 Year of the Cycle required.

$$\left.\begin{array}{r} 19a + 8 = 28b + 9 \\ 19a = 28b + 1 \\ \text{Subt. } 19 \quad\ \ 0 \\ \text{Rem. } \ 9b + 1 \end{array}\right\} \text{by } \textit{Prob. } \text{VI.}$$

Here b is equal to 2, and $28b + 9$ equal to 65, as before.

The foregoing Problems, maturely conſidered, will be found to extend to the Solutions of moſt of thoſe which are called *unlimited Problems*.

Other

Other Queſtions applicable to the CHRONOLOGER.

SUPPOSE a Perſon born *July* 17, 1671, What Day of the Week was it? This may be ſolved by *Prob.* I.

The Month, Day of the Week, and Date of the Year being given, to find what Day of the Month it is.

By the ſaid *Problem* alſo may be found all the Days of the reſpective Month, which that Day of the Week can happen on in the ſaid Year when it will be one of them.

Suppoſe a Perſon in the Year 1736, ſhould be about 40 Years of Age, and knew not the Year, but that he was born on a Sunday, *Auguſt* 18.

Here it is eaſy to diſcover, that *Auguſt* 1. muſt fall on a Thurſday, and conſequently F always in that caſe be the *Dominical Letter.*

Next, let the Age be eſtimated at 40 Years, which ſubtracted from 1736, gives 1696, the Year of Birth, for which Year finding the Cycle of the Sun, it will be 25, and D the *Dominical Letter* anſwering thereto; but, as before, it muſt be F, which happen'd the Year preceding, which is obvious among the Cycles in the

the *Chronologer*; therefore his true Age was 41, and born in the Year 1695.

Suppoſe in the Year 1736, a Perſon ſhould only ſay, that he was born on a *Good-Friday*, *March* 23.

Here, as *Good-Friday* is on *March* 23. *Eaſter Sunday* will be on the 25th; when by *Problems* III. IV. and V. all the Times in 532 Years it can ſo happen are already found (ſee *p.* 353.) where the Years of our Lord are,

	Year of Chriſt.	*Age.*
1736	1627	109
	1638	98
	1649	87
	1722	14
	1733	3

So that the Perſon may be any of the above Ages, from which, if living, it will be no hard Matter to determine the Age, or if you think you have not given ſcope enough, take twice the *Dionyſian* Period, *viz.* 1064, to which adding the firſt Numbers, *p.* 353. you will have the Years of our Lord for the preceding Period, &c.

Other Varieties relating to the *Chronologer* may be eaſily deduced from theſe and the preceding Principles.

The

The *Returns* of the *Moveable Terms*, of which the *Chronologer* only takes notice (the other being fix'd, therefore always the ſame) are thus denominated.

Eaſter-Term.

1ſt Ret. from the Day of *Eaſter*		in 15 Days.
2d Ditto	- - -	in 3 Weeks.
3d Ditto	- - -	in 1 Month.
4th Ditto	- - -	in 5 Weeks.
5th On the Morrow of the *Aſcenſion*.		

Trinity-Term.

1ſt	Ret.	On the Morrow of the *Holy Trinity*.
2d	——	In 8 Days, ditto.
3d	——	Fr. the Day of *H. Trin.* in 15 Days.
4th	——	Ditto, in 3 Weeks.

For the true Time of Eaſter.

Note, The firſt Full Moon that ſhall happen on or next after the Vernal Equinox, *viz.* when the *Sun* enters *Aries*, the *Sunday* following is *Eaſter-Sunday*; if the ſaid firſt Full Moon ſhould happen on a *Sunday*, then the next *Sunday* after will be *Eaſter-Sunday*.

The Reaſon for poſtponing the *Sunday* is, that the *Jews* always keep their Paſſover on the very Day of the firſt Full Moon on or next after the ſaid Vernal Equinox, which, if as before obſerved, ſhould happen on a *Sunday*, the *Chriſtians*, that it might not be thought to ſavour of *Judaiſm*, keep theirs on the *Sunday* (*viz. Lord's-Day*) following.

The

The Council of *Nice* in the Year of Chriſt 325, upon regulating the Feaſt of *Eaſter*, fix'd the Day of the Vernal Equinox on *March* 21. (tho' it really was, as may be eaſily found by Computation, on the 20th) and they, ſuppoſing the Vernal Equinox would always happen on the 21ſt of *March*, order'd *Eaſter* to be celebrated on the *Lord*'s-*Day*, &c. as before, following the next Full Moon after the ſaid 21ſt of *March*; from hence it may be ſeen, that when the Full Moon ſhall happen on a *Saturday*, *March* 21. *Eaſter-Sunday*, which, according to the above Rule, is to be the next *Sunday* following, will be on the 22d of *March*, and ſooner than this *Eaſter* can never happen.

Alſo, when the Full Moon ſhall happen on *March* 20. the Day preceding the Vernal Equinox, the next Full Moon after (the Space of a Lunation being 29 Days and a half) will not happen 'till *April* 18. which, if it ſhould be on a *Sunday*, then the *Sunday* following, *viz*. *April* 25. will be *Eaſter-Sunday*, and is the fartheſt that ever it can happen.

And this laſt Rule for finding *Eaſter* has prevailed ever ſince the ſaid Council of *Nice*, according to which and the *Metonic* Cycle of 19 Years (*viz*. the *Primes* or *Golden Numbers* which ſuppoſed the Lunations to return to the ſame Time, *viz*. Day of the Month, &c. as in each reſpective Year of the preceding Cycle) was the Table made for finding *Eaſter* for ever.

But

But neither the Vernal Equinox or *Metonic* Cycle is permanent; for in the Space of 132 Years the ſaid Vernal Equinox will be anticipated a little above a Day (ſee *p.* 102.)

And the Mean Motion of the Moon in 19 Leap (or 76) Years from the Tables is 3° 33′ 31″, that of the Sun 34′ 36″, neglecting the Thirds, as being under 30, the Diff. 2° 58′ 54″ is the Diſtance of the Moon from the Sun in 76 Years, the Diff. of the mean hourly Motion of the Moon from the Sun is 30′ 28″; whence it will be, as 30′ 28″ is to 1 ho. ſo is 2° 58′ 54″ to 5 ho. 52′ 21″, one Fourth of which is 1 ho. 28′ 5″, and ſo much is the *Metonic* Cycle anticipated every 19 Years, which in the Space of 310.6 Tropical Years amount to one Day.

From hence it may eaſily be computed, that the Equinox, ſince the Council of *Nice* to the Year 1736, is anticipated about 11, and the Lunations between 4 and 5 Days, and hence ariſe all the Differences about celebrating the Feaſt of *Eaſter*.

Pope *Gregory* XIII. with the Aſſiſtance of one *Lilius*, in the Year of our Lord 1582, in order to reſtore the Vernal Equinox to the 21ſt of *March*, as ſuppoſed at the Council of *Nice*, threw ten Days (at which time the Equinox was ſo much anticipated) out of the Calendar, making the 11th of *March* (the Day whereon the Vernal Equinox then happened) to be the 21ſt; and in order to fix it there, ordered every Hundredth Year, which ſhould be Biſſextile,

Bissextile, to be but a common Year, and this for three Centuries successively, and the fourth Century to be Bissextile, and so on continually.

From hence it may be observed, that in 400 Years there are three Days provided for, in which time the Sun's Mean Motion is 2° 57′ 25″; but against 100 (answering to 400 Years) in the Table of the Sun's Mean Motion, &c. every fourth or Leap-Year, the Equinox will be 3° 2′ 8″ 8‴ anticipated; so that there will still be the Anticipation of the Diff. *viz.* 4′ 43″ 8‴, to which answers 1 ho. 54′ 48″, &c. of Time, amounting in 50 Centuries to 23 ho. 56′ 24″, *i. e.* a Day wanting 3′ 36″.

Wherefore, if the last Year of every 50th Century had been also made a common Year, the Seasons would thereby not be interrupted a Day in two Millions of Years.

There having been, from the Crucifixion to the Council of *Nice*, about 300 Years, the Vernal Equinox was at the said Council anticipated at least two Days, to which Time they should also have gone back in this Regulation, in order to have kept up to the primitive Intent.

For the Time of Easter *in the* Gregorian Account.

First, Find the mean Time of the Change of the Moon about the Beginning of *March*, as in *p.* 343. and here it will be best to operate with the true Place of the Sun on the First of *March*, which is obtained accurate enough by always

always adding to the Mean Place thereon 1° 40′, which at a Mean will be found to anſwer for 4000 Years, and may be obtained for ever, thus,

Find the Mean Anomaly *March* 1. for the Year required, with which, taking out the Equation of the Sun's Centre, you have the Numbers ſought.

Next, adding 15 Days thereto, gives the Time of the Full Moon, which, if it ſhould happen before the Vernal * Equinox, by adding 29 Days and a half thereto, you will have the ſubſequent Full Moon, by which the true Time of *Eaſter*, as in *p.* 365. may eaſily be diſcovered.

To the true Time of *Eaſter*, thus found, add the Number of Days before us in the *Gregorian Account*, gives their Time of *Eaſter* required.

Example for the Year 1736.

The Year 1736, being the Radical Year, there are no Equations to be applied to the Mean Places of the Sun and Moon.

The true Place of the Sun on *March* 1. by adding 1° 40′ to the Mean, gives $11^s\ 22°$, and that of the Moon nearly the ſame; wherefore the Moon changed on the ſaid 1ſt of *March* about Noon (which it did at 3 h. P.M.)

Next, adding 15 Days, gives the 16th for the Day of the Full Moon, which, as C is the *Dominical Letter*, fell therefore on a *Tueſday*, and conſequently the *Sunday* following, *viz. March* 21. was the true Time of *Eaſter* †.

 To

* The Day of the Vernal Equinox is readily determined by adding a Degree for each Day to the Place of the Sun on the Firſt of *March*.

† But *Eaſter* was not celebrated with us 'till our 25th of *April*, which is five Weeks too late according to the primitive Deſign and Inſtitution.

To which adding the 11 Days before us in the *Gregorian Account*, gives *April* 1. the Time of their *Easter* required.

By Note, *p.* 347, the *Gregorian Dominical Letters* will be found to be AG, which last in this case is to be made use of, and under it in the *Chronologer* the Months *April* and *July* in their Account both begin on a *Sunday*, agreeing with *Easter-Sunday*, as above.

The Time of *Easter* found, all the *Moveable Feasts*, being dependent thereon, are easily obtain'd by the *Chronologer*, as follows.

Example. For the Year 1736.

Easter-Sunday, is *April* 25.

25 Days in *April*, and 24 out of *March*, are 49 Days, or 7 Weeks; therefore *Shrove-Sunday* is —— —— —— *March* 7

5 Days remaining in *April*, and 34 more, make 39 Days, and *May* having 31 Days; therefore *Ascension-Day* is —— —— *June* 3

5 Days in *April*, and 31 in *May*, are 36, and 13 more in *June*, make up 49, or 7 Weeks; therefore *Whit-Sunday* is *June* 13

Trinity-Sunday, being the next, is therefore *June* 20

And the *Dominical Letter* being C, *Advent-Sunday* is —— —— *November* 28, &c.

The

The *Terms* and their *Returns* are eaſily diſcovered by the ſame Method, *&c.*

Next to compleat an *Ephemeris* or *Diary* for any Year. Firſt, find the Sun and Moon, with the Nodes true Places at Noon, on the Firſt of *January*, with all the other Requiſites, as laid down by the *Chronologer*, by which you will diſcover the Diſtance of the Sun from the Moon, and by (*p.* 340. 343.) Rules beforegoing the Day of the Change to this Day at Noon. Compute again the true Places of the Sun and Moon alſo on the 7th, 15th, and 22d Days, both before and after the ſaid Change; by their Places thus at Noon may the Diſtance of the Moon from the Quarters and Oppoſitions of the Sun be taken, which multiplied by 2, gives the Hours, *&c.* to be applied to the Noon of the ſaid Days, which gives the Time required.

Alſo, by the Diſtance of the Sun from the Node, may be ſeen, when there will be an Eclipſe of either Luminary, (ſee *p.* 292.)

For the *Riſings* and *Settings* of the Sun and Moon, as alſo the Moon's *Southing* (ſee *p.* 336, *&c.*)

For the Tides.

It is obſerved at *London-Bridge*, that at the Change and Full of the Moon it is High-Water about half an Hour after Two of the Clock, and at the Quarters about half an Hour after Seven.

Therefore, from the said Change and Full of the Moon to the Quarters, there are 5 ho. Difference in the Tides.

Next, as the mean Time of a Lunation is 29 Days and a half, if the said 5 ho. be divided by one Fourth thereof, it will be about 40 min. for the mean Time of the Tides every Twenty-four Hours, and as there are two Tides in that Time, it will be about 20 min. each Tide.

Again, from the Time of High-Water at the Quarters, *viz.* half an Hour after Seven, to that of the Full and Change, *viz.* half an Hour after Two, are seven Hours, which divided also by one Fourth of a Lunation, gives nearly an Hour in the latter Case for every Twenty-four Hours, *viz.* about 30 min. each Tide, and this will ever be found near enough in Practice, and within a few Minutes of the true.

By this Method, knowing the Times of High Water at the Change and Full at any other Place, the same at any intermediate Time may also be computed.

If you would still be more exact, you must take the true Time between the Quarters, *&c.* of each Lunation, which may easily be done by the foregoing Methods, by which dividing the 5 and 7 Hours, as before, the respective Quotients give the Answers required.

All

All the preceding Calculi being made to the Changes, Quarters, &c. of the Moon, as before directed, for any Day between, as Occaſion ſhall require, the ſame may be obtained with little more than Inſpection.

And here it may not be unworthy the Notice of an Ephemerediſt, who gives the Places of the Sun each Day no farther than to Minutes, that, if the Places of the Sun be obtain'd true for every Day in any one Year, (which I ſhould chuſe to be *Biſſextile*) by applying thoſe Numbers only, which would reduce the mean Places in the ſaid Year to the mean Places for twenty Years ſucceſſively, to the true Places before found, you will thereby have the true Places inſtead of the mean for the ſaid Number of Years to about one Third of a Minute.

To the above Calculations you may likewiſe put the Day of the Week to the firſt Day of each Month, whence the other Days of the Week, by the preceding Methods, are at any time eaſily obtained.

The Method, uſed in all Ephemerides and Almanacks, is to put to the firſt Day of every Year the Letter *a*, the ſecond Day *b*, the third *c*, and ſo on to *g*, the firſt ſeven Letters anſwering to the firſt ſeven Days of every Year, and that Letter, which anſwers to *Sunday*, is always made a Capital Letter, and is called *Dominical*, from pointing out the *Lord's-Day*, or *Sunday*; ſo that whatever Letter points out its reſpective Day in the firſt Week of the ſaid Year,

Year, the ſame Letter points out the ſame Day of the Week throughout the whole Year.

If the Year begins on a *Sunday*, then a Capital A, being *Dominical*, points out not only that *Sunday*, but every *Sunday* in the Year, and the other Letters to *g* in ſmall Characters, each its reſpective Day throughout the Year, as before, which is obvious from the Notation.

Next, it may be obſerved, that in a Year of 365 Days, whatever Day of the Week the ſame begins on, the ſame Day thereof it will end: As for Example, let the ſame begin on a *Sunday*; the remaining Number of Days in the Year, *viz.* 364, divided by 7, the Days in each Week, gives 52 Weeks, and leaves no Remainder; whence conſequently, the Year will end alſo on a *Sunday*, and the ſucceeding Year will therefore begin on a *Monday*, *&c.*

But *a*, being put to the firſt Day of every Year, when the ſame does not begin on *Sunday* it muſt be a ſmall Letter; next, ſuppoſing it to begin on a *Monday*, count from *Monday*, calling it *a*, *Tueſday b*, *&c.* 'till you come to *Sunday*, to which the Letter G will now anſwer, and is therefore a Capital, as being the *Dominical* or *Sunday-Letter*.

Proceeding in the ſame manner, the next Year, which will begin on a *Tueſday*, F will be found to be the *Dominical Letter*, the following Year E, and ſo on, each Letter taking place, as *Dominical*, in a retrograde Order.

From

From whence 'tis plain, that if every Year conſiſted but of 365 Days, after ſeven Years the *Dominical Letters* would return again, proceeding in the ſame Order as before.

But every fourth Year, being *Biſſextile* or *Leap-Year*, there is introduced another Day, (which may be taken on the laſt, *viz.* on the then 29th Day of *February*) and conſequently another Letter to anſwer it, which will likewiſe bring another *Sunday-Letter* into the Account, *viz.* the next of the ſeven preceding the former, which is the Reaſon why every *Leap-Year* there are two *Dominical Letters*, whence, inſtead of the Letters returning in the ſame Order after every ſeven Years, as before, it will now be four times Seven, or 28 Years, and on theſe Principles was the Table of *Dominical Letters* and *Cycles* of the *Sun* compoſed.

The moſt remarkable and moſt certain Epocha's *uſeful in* Chronology.

OLYMPIADS, Year of *Julian* Period — — 3938
commencing at the New Moon next after the Sum Solſtice, each containing 4 Years.

Building of *Rome*, U.C. Year of the *Julian* Period according to *Varro* — 3961
according to *Faſti Capitolini* — 3962
commencing *April* 21.

Nabonaſſar, *Feb.* 26, *Julian* Period — 3967

Death of *Alexander* the Great, *Nov.* 12. *Julian* Period — — — 4390

Julian

Julian, ſettling the Calendar by *Julius Cæſar*, *Jan.* 1. *Julian* Period —	4668
Turkiſh, (Flight of *Mahomet*) *July* 16. d°	5335
Perſian, *June* 16. — — —	5345
Martyrs, firſt Year of *Diocleſian*, *Auguſt* 29. *Anno Domini* — — —	284

Having *p.* 369. ſhewn how to find the *Gregorian Eaſter* for any future Time, it may not be amiſs to ſhew the ſame for any Time paſt.

Accordingly, let it be required for the Year 1670.

I ſhall work this Example by the *Tables*, after the Manner of diſcovering *Eclipſes*.

The Proſthapheresis to be applied to the mean Place of the Sun (ſee *p.* 104.) will be found about one Degree ablative; but at the ſame time there is 1° 40′ to be added for the true Place on the Firſt of *March*, the Difference therefore added, gives 11^s 21° for the true Place of the Sun, and allowing about a Degree a Day, the Vernal Equinox will be found to fall on the Tenth of *March*.

The Proſthapheresis for the Moon will be found * 7^s 27° *ferè* additive, which ſubtracted from 11^s 21° the above Place of the Sun, leaves 3^s 24°, which being ſought among the Mean Places of the Moon in the Table, *March* 1736. the next neareſt thereto is 3^s 21° and againſt it anſwers the tenth Day of the Month, to which adding 9° for the nine Days from the Firſt of the Month excluſive, gives

4^s,

* See *p.* 122, 123.

4°, to which now answers the 11th Day nearly for the Change of the Moon; next adding 15 Days thereto, gives 26th for the Day of Full Moon, and, consequently, the *Sunday* following was the true Time of *Easter*.

The *Julian Dominical Letter* for the above Year is B, whence *March* begins on a *Tuesday*, and the 26th, the Day of Full Moon, fell on a *Saturday*; wherefore *Sunday* the 27th was the true Time of *Easter* required.

But, before the Year of Christ 1700, the *Gregorian Account* was only ten Days before us, which added to the 27th of *March* before found, gives *April* the 6th, the Time of their *Easter* required.

The *Julian Dominical Letter* being B, and the *Gregorian Account* 10 Days before us, by counting 10 from B exclusive, among the seven *Dominical Letters* immediately over the Months and under the *Cycles* (see *p.* 305.) in a direct Order, you will end at E, which is the *Gregorian Dominical Letter*, (and which, in a retrograde Order, is the fourth preceding B) whence the First of *April* begins on a *Tuesday*, and, consequently, the 6th is on a *Sunday* as before.

The *Prime* for the said Year was 18, by which and the *Dominical Letter* our *Easter* will be found to have fell on *April* 3. but should have been on *March* 27. as above; wherefore it was celebrated a Week too late.

The *Tables*, *p.* 285, 286 and 287, being not common, I shall give an Instance of their Uses.

First, by former Rules *p.* 334. and Table, *p.* 277. find the Declination of the Moon.

Then, for her Meridian Altitude.

If the Declination before found, and the Latitude of the Place, be of one Denomination, *viz.* both North or both South, the said Declination, in that case, being added to the Complement of the Latitude, gives the Meridian Altitude required.

But, if the Declination and Latitude of the Place be of different Denominations, their Difference will be the Meridian Altitude requir'd.

Next, for the Use of the aforesaid *Tables.*

Let it be required to find the Time of the Transit of the Moon over the Meridian

	°	′	″
The Horizontal Diameter being		29	30
Declination	25	0	0
Meridian Altitude	63	0	0

Moon's Horizontal Diameter - -		29	30
For Declination 25°, *p.* 286. -	+	3	2
For Alt. 63°, *p.* 274. at a Mean		0	28
		33	0
Against which in the *Table* of the Rotation of the Earth, *p.* 285. are about 2 ¼, and the Moon's Mean Motion answering thereto, *p.* 202.		1	14
		34	14

Against

Against 30′ 5″ in the aforesaid *Table* of Rotation are 2′, when there will be the odd 4′ 9″ to proportion for; thus, as 15′ 2″ (which 2″ may be neglected) are to 1′ of Time, so are 4′ 9″ to 16″ 36‴, which, as the Thirds are above 30, may be taken 17″, and so the whole Time of the Transit will be found 2′ 17″.

It will be very easy at any Time from these *Tables*, &c. for an Observer so to elevate his Mural Quadrant, as never to miss the Object; which Mural Quadrant, according to the new Methods of Observing, with all other Mathematical Instruments, are made in the most accurate and approved Manner, by *Tho. Heath*, Mathematical Instrument-Maker, in the *Strand*.

The Methods for finding the Moon's Southing by the *Chronologer*, tho' very near, yet is not exact enough to compare with Observation, for which Purpose on that Day at Noon, whereon the Observation is to be made, you must compute the true Places of the Luminaries, &c. and from thence their Right Ascensions in Time in Hours, Minutes, Seconds, &c. Then from the Right Ascension of the Moon, thus found, subtract that of the Sun, adding 24 ho. if Occasion; next, for this Difference in Hours &c. find the true Place of the Moon again, as also her Right Ascension in Time, from whence subtracting the Right Ascension of the Sun in Time, as before, gives her true Time of Southing required; to which last Time the Moon's Apparent Place must now be found.

Hitherto the Centre of the Moon has only been considered; but if it be required to know when her Limb or Disk shall touch the Meridian, then her Semi-diameter must be considered;

dered; when, if ſhe be between the Change and the Full, it will be her Weſtern Limb, at which Time her Semi-diameter muſt be ſubtracted from her aforefound Place; but, if it be between the Full and Change, it will be her Eaſtern Limb, when the ſaid Semi-diameter muſt be added, *&c.*

The Computations at the End are deſign'd as Examples to be traced over at any Time.

The third is that for the Eclipſe of the Moon, *March* 15. 1736. in which is omitted the 2d Equation according to Sir *Iſaac*, amounting to 3′ 33″ ablative; alſo the fourth Equation amounting to 1′ 51″ likewiſe ablative, both which are 5′ 24″, making it above 9 Minutes in Time later than by the ſaid Computation †.

† *See the* Preface.

There are * 3′ 33″ ſhort of the Oppoſition denoted by the Aſteriſm, which requires 6′ 6″ of Time for the true Oppoſition, as found by the Difference of the Hourly Motion of the Sun from the Moon, in which Time the Sun will be advanced 15″ forward, making his Place 0ˢ 6° 36′ 35″, and that of the Moon the direct Oppoſite, from which laſt Place of the Moon the true Place of the Node is there taken, and the Moon's Latitude found accordingly.

This Eclipſe happening when the Moon was upon the Meridian, her Altitude was 41 Deg. and being very near the Perige, her Semi-diameter is therefore increaſed by 12″ (ſee *p.* 274.)

The Place of the Moon is alſo computed for an Hour forwarder, to gain her true Motion for that Time, which is 37′ 20″, when if the ſame be obtained by the Method, *p.* 301. with 60′ 52″, preſent Horizontal Parallax, which there by Miſtake was taken 60′ 51″, it will be found to be 37′ 19″, and is within a Second of that by Computation.

The

The Computation *of the ſaid* Eclipſe *on the aforeſaid Principles, compared with* two Obſervations, *taken out of the* PHILOSOPHICAL TRANSACTIONS, N° 445. Anno 1737.

Obſervation by *John Bevis, M. D. Covent-Garden, March* 15. 1736.	h.	′	″		By *Computation, March* 15. 1736.	h.	′	″		Obſervation by Mr. *George Graham, Fleet-ſtreet, March* 15. 1736.	h.	′	″	
Beginning	10	11	40	P.M.	Beginning	10	12	39	P.M.	Beginning	10	13	0	P.M.
Total Immer.	11	10	0		Total Immer.	11	10	47		Total Immer.	11	11	0	
Emerſion not taken					Emerſion	12	50	1		Emerſion	12	49	0	
* End Shad.	13	48	30		End Eclipſe	13	48	9		End Eclipſe	13	47	0	

From whence it is obvious, that the Equant computed by Mr. *Machin*, renders the aforeſaid Equations of the Theory, as noted in the *Preface*, of no Uſe in the Syzygys.

* In this Computus there are 50 Seconds added for the Earth's Atmoſphere.

The fourth and last Computus is for the Occultation of *Aldebaran*, in which the Place of the Moon is computed for half an Hour before, &c.

Or the Hourly Motion of the Moon out of the Syzygys may be obtained by the following Method.

First, find it as if in the Syzygys (see *p.* 301.) which in this Example will be found 29′ 24″; next, take out the Difference of the Variations between the present Sign and Degree, and next greater Degree of ☉ à ☽ the second Time Equated (which in this Example are 5ˢ 4° and 5ˢ 5°, and the Difference 42″) half of the Difference must always be subtracted from 34″, and the Remainder, when the Variation was added, be subtracted from, and when subtracted, added to the Motion, as if in the Syzygys before found; half of the Difference in this Example is 21″, which subtracted from 34″, leaves 13″ to be added by the above Rule to the Motion before found, *viz.* 29′ 24″, which gives 29′ 37″; lastly, observe the like with the Reduction to the Ecliptic, half of which Difference, applied as the *Table* directs, to this last Motion found, gives the true Hourly Motion of the Moon out of the Syzygys required.

In this Example the ☊ à ☽ in her Orbit is 9ˢ 24°, between which and 9ˢ 25° are 9″ Diff. of Reduction, half of which, *viz.* 4″, applied as the same was increasing, according to the Title of the *Table*, *viz.* added to 29′ 37″, before found

found, gives $29' \, 41''$ for the true Hourly Motion of the Moon out of the Syzygys required, half of which, *viz.* $14' \, 50''$ is equal to the half Hourly Motion by Computation, ſee the *Computus*, &c.

Note, If the ☊ à ☽ in her Orbit had been 11^s, or $5^s \, 3^\circ$, the Difference in that Caſe would be $9''$ decreaſing, when the Half, *viz.* $4''$ muſt, contrary to the Title, be ſubtracted inſtead of added, as before, which is very obvious.

The farther Calculi of this Occultation are left for the Exerciſe of the Curious, and here it is to be noted, that the *Computus*, according to the Theory, is $4'$ ſhort hereof, ſee *p.* 164 and 331.

APPEN-

APPENDIX.

THE Contraction in *Division of Decimals*, not being of so general Use as in *Multiplication*, was forgot to be inserted in its proper Place; and lest the Theory thereof may not be thought perfect without it, observe the following Rules.

Having determined the Value of the first Digit of the Quote, proceed therewith as usual; next, instead of bringing down to the Remainder a Cypher or Digit each Time from the Dividend, point off a Place in the Divisor, not making use of any Digit, &c. in the Product made by the Digit in the Quote and Divisor, 'till you come to that Place in the Divisor immediately preceding, to the Left-hand, the Place last pointed off in the Divisor; continue thus 'till the Division be ended, having regard at the same time (as in Contraction of *Multiplication*) of the Carriage from a Place or two in the Divisor, to the Right-hand of the Place pointed off therein.

This will be made plain from the following Examples.

Example

Example I.

```
384.672158 ) 14169.2066239510 ( 36.8345
 ......        262904188
                32100893
                 1327121
                  173105
                   19236
                  (0002)
```

Here the Place of Unity in the Product, made by the first Digit in the Quote and Units Place in the Divisor, fell under 6 among the Integers in the Dividend, which being the Place of Tens, the Value of the Place of the first Digit of the Quote will be such *.

Example II. *in Circulates.*

Here I shall resume the *Example*, *p.* 90.

```
2.172 ) 243.30630
   21     243306
------  ---------
2.151   240.87324 (
```

In this case the Divisor, as consisting of the least Number of circulating Places, is first clear'd (see *p.* 89.) next the Divisor must now be ordered according to the Number of circulating Places in the Dividend, as follows.

Ddd 2.151

* See *pag.* 40.

```
2.151        240.87324
  2151         24087
_________    __________
2.148849 ) 240.63237 ( 111.982
.....        257474
              42589
              21101
               1763
                 44
                (1)
```

If this Example be compared with the ſame in *p.* 90. the Truth of operating in this contracted manner will evidently appear.

Here it may alſo be obſerved, as before, that the Units Place of the Diviſor falls under the Place of Hundreds among the Integers in the Dividend, and conſequently the firſt Figure of the Quote will be of the ſame Value in Place.

Or, by *Example* VI. *p.* 38. a Cypher muſt be added to the Dividend to make the decimal Places therein equal to thoſe in the Diviſor, when the Quote will be ſo far Integral, and contain three Integral Places, as above.

When the Number of circulating Places in the Dividend are leſs than in the Diviſor you muſt proceed in like manner, clearing the Dividend firſt, next the Diviſor, *&c.*

In the following Computation by the *Chronologer* it will be neceſſary to inſpect the Pages referr'd to for the Work.

As

As *July* 23. was nearer the Firſt of *Auguſt* than the Firſt of the ſaid Month, the Mean Places on the ſaid Firſt of *Auguſt* are therefore made uſe of, and the Mean Motions for the Number of Days, by which it exceeds the ſaid 23d of *July*, *viz.* 9, ſubtracted therefrom, which Method (in the like Caſes) will be always beſt to be purſued.

COMPU-

(1)

COMPUTATION *of the* Places *of the* LUMINARIES, July 23. 1738. *at Noon*, *by the* TABLES. Equal Time.

☉'s Mean Longitude.

s	°	′	″	‴	
4	12	18	35	8	1736, July 23.
	—	28	39	26	+2 Ye. à Rad.
4	11	49	55	42	1738 July 23.
	—1	3	9	42	Equ. ☉ Centre
4	10	46	46		☉ true Place

☉'s Mean Anomaly.

s	°	′	″	
1	4	3	29	1736 July 23.
	—30	41		+2 Ye. à Rad.
1	3	32	48	1738 July 23.

547

	′	″
Equation Ti. ☉ Place	+9	50
D° ☉ Anomaly	—4	12
True Equation of Time	+5	38

☽'s Mean Longitude.

s	°	′	″	
3	0	21	20	1736 July 23.
+8	18	46	7	+2 Ye. à Rad.
11	19	7	27	1738 July 23.
		+6	34	First Equation
11	19	14	1	☽ 1st Ti. Equated.
	+5	32	43	Ellipt. Equation

☽'s Apogé.

s	°	′	″	
11	15	18	13	1736, July 23.
+2	21	19	41	+2 Ye. à Rad.
2	6	37	54	1738 July 23.
		—11	55	First Equation
2	6	25	59	Apo. 1st Ti. Equat.
2	4	40	47	D° à ☉

☽'s ☊.

s	°	′	″	
5	29	36	26	1736, July 23.
—1	8	39	26	+2 Ye. à Rad.
4	20	57	0	1738 July 23.
		+4	51	First Equation
4	21	1	51	☊ 1st Ti. Equated.
11	19	44	55	D° à ☉.

—30 28 ☊ 2d Ti. Equated.

11	24	46	44	☽ 2d Ti. Equated.
		+32	19	Variation.
11	25	19	3	☽ in her Orbit.
		−6	52	Reduc. and Excefs.
11	25	12	11	☽ in the Eclipt.

	°	′	″
Mean Elliptic Equa.	+6	17	12
Reduction d°		−44	29
True Elliptic Equa.	+5	32	43

+10	52	4		2d Equ. Apog.
2	17	18	3	Tr. Pl. Apog.
9	1	55	58	☽ Mean Anom.
2	28	4	2	Compl. d°
7	13	59	58	☉ à ☽ 2d Ti. Equ.

Conftant Log. ——— 9.957762

°	′	″		
44	2	1	$\frac{1}{2}$ Mean Ano.	
		+11	Equ. to d°	
44	2	12	Tangent.	9.985393
41	15	99	Tangent.	9.943155
2	46	22	Diff. à $\frac{1}{2}$ Mean Anom.	
		×2		
5	32	44	True Ellipt. Equation.	

		−30	28	☊ 2d Ti. Equated.
4	20	30	23	Tr. Pl. ☊.
		17	15	Incl. Limit.
7	4	48	40	☊ à ☽'s Orbit.
3	0	58		☽ Lat. So. Afcen.

(2)

Computation *of the* Places *of the* Sun *and* Moon, July 23. 1738. *at Noon, by the* CHRONOLOGER. Equal Time.

⊙ Me. Long.

s	°	′	″	
4	21	10	50	1736, Aug. 1.
—	8	52	15	* Days to go back 9
4	12	18	35	1736, July 23.
	—	28	40	+ 2 Ye. à Rad.
4	11	49	55	1738 July 23.
—	1	3	9	Equ. ⊙ Centre
4	10	46	46	⊙ true Place

⊙ Me. Anom.

s	°	′	″
1	12	55	42
—	8	52	13
1	4	3	29
	—	30	40
1	3	32	49

·547

		′	″
Eq. Ti. ⊙ Pl.	+	9′	50
D° Anom.	—	4	12
Tr. Eq. Ti.	+	5	38

Equ. ⊙ Cent. at 1^s $4^°$ Ano.			—3835″
D° ———	1	2 d°	—3633
Diff. Increaſ.		2	202
Diff betw. next leſs and preſ. Ano. Increaſ.			$1^°$.547
3633″ againſt 1^s $2^°$ Ano.			202″
+ 156 Propor. Pts.			
			3094
3789 Eq. ⊙ Cent. —			3094
			2)312″.494
			156

* See the Work, *p.* 392.

☽ Me. Long.

s	°	′	″	
6	28	56	35	Aug. 1.
+4	20	10	52	* Days to go back 9
11	19	7	27	1738 July 23.
		+6	34	† 1st Equation
11	19	14	1	☽ 1st Ti. Equat.
	+5	32	43	‡ Elliptic Equation
11	24	46	44	☽ 2d Ti. Equat.
		+32	19	Variation
11	25	19	3	☽ in her Orbit
		+6	50	Reduc. and Excess
11	25	12	13	☽ in Eclip.

	°	′	″
Me. Ellipt. Equ. ——	+6	16	34
Reduction ——		−43	51
	+5	32	43

☽ Apoge.

s	°	′	″	
11	16	18	22	
+2	20	19	32	* Days to go back 9
2	6	37	54	
		−11	56	† 1st Equation
2	6	25	58	Apo. 1st Ti. Equat.
2	4	20	48	D° à ☉
	+10	50	38	2d Equ. Apoge
2	17	16	36	Tr. Pl. Apog.
9	1	57	25	☽ Me. Anom.
2	28	2	35	Compl. d°
7	13	59	57	☉ à ☽ 2d Ti. Equ.

☽ Node ☊

s	°	′	″	
5	29	7	49	
−1	8	10	45	* Days to go back 9
4	20	57	4	
		+4	52	† 1st Equation
4	21	1	56	☊ 1st Ti. Equat.
11	19	44	50	D° à ☉
	10	15	10	Compl. d°
		−30	38	2d Eq. ☊ In. Lim. 18′
4	20	31	18	Tr. Place ☊
7	4	47	44	☊ à ☽ in her Orbit
	3	0	0	☽ Lat. So. Ascen.

* See the Work, p. 392. † See ditto, p. 395. ‡ See ditto, p. 394.

☉ Mo. *per Diem*	—	$.98565$
Days to go back		9
		$8^{\circ}.87085$
		60
		$52'.2510$
		60
		$15''.060$

☉ Ano. *per Diem*	—	$.9856$
Days to go back	—	9
		$8^{\circ}.8704$
		60
		$52'.224$
		60
		$13''44$

Work to the *Computus*, by the *Chronologer*, p. 391.

	Cir.	Mean Eccentricity	5505
☽ Mean Motion 1 Year	·359401	Present	4860
à Rad. 2 Ye.	2		
		Difference	645
Cir.	+ ·718802		
☽ Me. Mo. 1 Day .036601	− ·329410	Constant Differ. between Me. and least Eccentr.	1173
Days to be deducted 9	+ ·389392	Diff. betw. Me. and least Equa. 4785″ from Tab. Red.	
	6*		
−·32941		Then, as 1173 : 645 :: 4785″ : 2631″, *viz.* —43′51″ Reduct. Me. to the true Ellip. Equa. as above.	
	2336352		
	6*		
4^s 20° =	*140°.18112		
	60		
	10′.8672		
	60		
	52″.032		

* *N.B.* Multiplying by 6, and that Product again by 6, and next pointing off one Place less for Decimals in the last Product, is multiplying the first by 360, &c.

Work to the *Computus*, by the *Chronologer*, *p.* 391.

		Cir.
Me. Mo. ☽ Apo. 1 Ye.		.11295
à Rad. 2 Ye.		2
		.22591
		6
		135546
		6
Me. Mo. Apo. 1 Day	6′ 41″	*81°.3280
Days to be deducted	9	60
	60′ 9″	19′.68
		60
		40″.8

		Cir.
Me. Mo. ☊ 1 Ye.		.05369
à Rad. 2 Ye.		2
		.10738
		6
		64428
		6
Me. Mo. ☊ 1 Day	3′ 11″	*38°.6568
Days to be deducted	9	60
	—28′ 39″	39′.408
		60
		24″.48

Work to the *Computus*, by the *Chronologer*, p. 391.

Eq. ⊙ Cent.	−3789″	Eq. ⊙ Cent.	−3789″	Eq. ⊙ Cent.	−3789″
✕r. to 1ft Equation	.104	✕r.	.18	✕r.	.077
	15156		9)30312		26523
	3789		33680		26523
1ft Equa. ☽	+394″.056		3789	1ft Equa. ☊	+291″.753
		1ft Equa. Apo.	−715″.70		

(3)

COMPUTATION *of the* Places *of the* LUMINARIES, March 15. 1736. *at* 12.*ho.* P. M. Equal Time.

☉'s Mean Longitude.

s	°	′	″	‴	
	4	10	32	18	1736, March 23.
	—	29	34	10	+2 Ye. à Rad.
0	4	40	6	28	1738 March 15.
+1	56	13	45		Equ. ☉ Centre
0	6	36	20	13	☉ true Place

☉'s Mean Anomaly.

s	°	′	″	
8	25	56	47	
	+29	34		
8	26	26	21	
	.44			

	′	″
Eq. Ti. ☉ An.	+7	45
D° Place	—2	10
Tr. Eq. Ti.	+5	35

Equation ☉ Centre.

	°	′	″
Against 8s 27° ☉ Anom.	1	56	16
D° 8 26 D°	1	56	12
Difference increasing			4

$.44° \times 4'' = 1''45''' + 1°56'12'' = 1°56'13''45'''$

☽'s Mean Longitude.

s	°	′	″	
5	27	24	47	1736 March 15.
+	6	35	18	+2 Ye. à Rad.
6	3	59	45	1738 March 15.
	—12	5		Ann. Equation
6	3	47	40	☽ 1st Ti. Equated.
+2	45	11		Ellipt. Equation

☽'s Apogé.

s	°	′	″	
11	00	49	14	
		+3	21	
11	00	52	35	
		+21	56	Ann. Equation
11	1	14	31	Apo. 1st Ti. Equat.
1	5	21	49	D° à ☉

☽'s ☊.

s	°	′	″	
6	6	29	29	
		—1	35	
6	6	27	54	
		—8	54	Ann. Equation
6	6	19	0	☊ 1st Ti. Equated.
6	0	17	20	D° à ☉.

6	6	32	51	☽ 2d Ti. Equated.
			−4	Variation.
6	6	32	47	☽ in her Orbit.
	*	3	33	Short of the Opposi.

☽ Me. Long. computed 1 h. forward.

s	°	′	″	
6	3	47	40	☽ 1st Ti. Equat.
		32	56	☽ Me. Mo. an ho.
6	4	20	36	☽ d° Equ.
	+2	48	55	Elliptic Equation
6	7	9	31	☽ 2d Ti. Equat.
			+36	Variation
6	7	10	7	☽ in her Orbit
6	6	32	47	D° as above sub.
		37	20	☽'s Ho. Mo.

+10	38	54		2d Equ. Apog.
11	11	53	25	Tr. Pl. Apog.
6	21	54	15	☽ Mean Anom.
5	8	5	45	Compl. d°
5	29	56	31	☉ à ☽ 2d Ti. Equ.

☽ Apoge computed 1 h. forwarder.

s	°	′	″	
11	1	14	31	1st Ti. Equ. as above
			+17	Me. Mo. an ho.
11	1	14	48	Apo. d° Equat.
1	5	24	0	D° à ☉
+10	39	20		2d Equ. Apoge
11	11	54	8	Tr. Pl. Apog.
6	22	26	28	☽ Me. Anom.
5	7	33	32	Compl. d°
6	0	30	43	☉ à ☽ 2d Ti. Equ.

			−55	2d Eq. In. Li. 17 45
6	6	19	55	Tr. Pl. ☊.
		16	40	☊ à ☽ in her Orbit
		1	46	☽ Lat. No. Ascen. at ☋ Orbit

☉ tr. Pl. 1 h. forw. 0ˢ 6° 38′ 48″

	′	″
☽ Horizontal Parallax —	60	52
D° Semi-diameter —	16	40
☉ D° — —	16	6
☽ Hor. Mo. Orbit —	37	20
☉ D° — —	2	28
☽ D° à ☉ —	34	52
Reduc. à ☋ Orb. to Mid. Ecl.		−7
+ to Semi-diam. ☽ for Alt.		12

(4)

1738, Equal Time.
Dec. 12. 6 ho. 43′ 10″ P. M.

s	°	′	″	1738, D° ☽ Mean Longitude.
2	3	51	40	
		+1	20	Ann. Equation
2	3	53	0	☽ 1st Ti. Equ.
	+2	37	17	Ellip. Equ.
2	6	30	17	☽ 2d Ti. Equ.
		−27	52	Variation
2	6	2	25	☽ in her Orbit.
		+5	12	Reduc. and Exc.
2	6	7	37	☽ in Eclipt.

☉ true Place s 9, ° 1, ′ 51, ″ 18 } Eq. Ti. ☉ Pl. +40″; D° Anom. −51; Tr. Eq. Time −11

s	°	′	″	☽ Apoge.
2	22	29	0	
		−2	25	Ann. Equation
2	22	26	35	Apo. 1st Ti. Eq.
6	9	24	43	D° à ☉
	+3	16	34	2d Equ. Apo.
2	25	43	9	Tr. Pl. do
11	8	9	51	☽ Me. Anom.
0	21	50	9	Compl. d°
5	4	38	59	☉ à ☽ 2d Ti. Eq.

☉ Mean Anomaly s 5, ° 23, ′ 45, ″ 40

s	°	′	″	☽ Node ☊.
4	13	24	55	
			+59	Ann. Equation
4	13	25	54	☊ 1st Ti. Equ.
	−1	28	48	{ 2d Equ. ☊ In. Li. 10′ 3″
4	11	57	6	Tr. Pl. ☊
9	24	5	20	☊ à ☽ in her Orb.
	4	33	26	☽ Sim. Lat. Incr. 16′ 12″
		9	11	Pref. Inc.
	4	42	37	☽ tr. Lat. S. def.

	°	′	″
Me. Ellip. Equation	+ 2	13	58
Reduc. d°		+ 23	19
True Ellip. Equation	2	37	17

True Long. Aldeb. at Time above.
♊ 2ˢ 6° 7′ 35″

Horizontal Parallax	53′	48″
☽ d° Semi-diameter	14	44
☽ Horary Motion	29	41

Latitude Aldebaran.
5° 29′ 50″

Computation for ½ ho. back ☉ and ☽

s	°	′	″	
2	3	36	32	☽ 1ſt Ti. Eq. ½ h. bac.
	+ 2	39	4	Ellip. Equa.
2	6	15	36	☽ 2d Ti. Equa.
		—27	59	Variation
2	5	47	37	☽ in her Orbit
		+ 5	10	Reduc. and Exc.
2	5	52	47	

s	°	′	″	
9	1	50	1	☉ tr. Pl. ½ ho. back
2	22	26	27	Apo. 1ſt Ti. Equ. d°
6	9	23	34	D° à ☉
	+3	16	10	2d Equ. Apo.
2	25	42	37	Tr. Pl. Apo.
11	7	53	55	☽ Me. Anom.
0	22	6	5	Compl. d°
5	4	25	35	☉ à ☽ 2d Ti. Equ.

s	°	′	″	
5	23	44	26	☉ Me. Ano. ½ ho. back
4	13	25	58	☊ 1ſt Ti. Equ. d°
4	18	24	3	D° à ☉
	—1	28	48	2d Equ. ☊
4	11	57	10	☊ tr. Pl.
9	23	50	27	☊ à ☽ in Orbit
	4	33	57	☽ Sim. Lat. In. 16′ 13″
		9	11	Preſ. Incr.
	4	43	8	☽ Tr. Lat. So. deſcen.

Work to *Computus* (3.) p. 396, 397.

		°	′	″
Mean Elliptical Equation	—	+2	28	47
Reduction d°	———		+16	24
True Elliptic Equation	—	+2	45	11

9.947865 Constant Log.
10.712569 Tang. ½ Comp. ☽ Me. Ano.—1′ 4″

10.660434 Tang. 77° 40′ 17″ which subtracted from ½ Comp. ☽ Me. Ano. 79° 2′ 52″ ½ and Rem. × 2 is Ellipt. Equa. &c. as above.

		s	°	′	″
☉ true Place an Hour forwarder	—	0	6	38	48
Mean Elliptic Equation	— —		+2	32	12
Reduction d°	— —			+16	[illegible]
True Ellipt. Equa. 1 h. forwarder			[illegible]	48	[illegible]

F I N I S.

ERRATA.

For	Page	Lines	Margent.	Read
Pages 124, 128, 167, 168, 169, 170, 172, 173, 174,				224, 218, 177, 178, 179, 180, 182, 183, 184
	8	5		*dele* to
Decimal, only	10	25		Decimal only,
.005	15	8		.007
(In Operation 1.) 9	21	7		.9
.27	60	11		.27
.27	ib.	12		.27
.27	ib.	14		.27
48	ib.	15		.48
124568	62	2		12.4568
6.545	63	4		6.545
23.23984	66	14		23.23984
70005.99999	73	11		70004.99999
11198	77	14		111.98
1	82	7		3
300837	ib.	17		30.0837
6.012	84	10		6.012
.22	86	2		.2
.2727	ib.	9		.27, &c.
.27	ib.	10		.27, &c.
.99, &c.	ib.	18		.9, &c.
above	102	19		as above
Seventh	136	5		Sixth
Apoge 3 13	143	11		2 13
$11^s\ 29^o\ 59'\ 38''$	172		19	$10^s\ 29^o\ 59'\ 38''$
$9^s\ 20^o\ 59'\ 56''\ 12'''$	179		31	$9^s\ 20^o\ 59'\ 56''\ 11'''$
Sine	182, 183, 184	3		Sign
3 3	185		20	3 32
(under Apoge) $10^s\ 18^o\ 35'\ 33''$	191		24	$10^s\ 28^o\ 35'\ 33''$
$10^s\ 27^o\ 2'\ 59''$	194		20	$10^s\ 27^o\ 3'\ 59''$

For	Page	Lines	Margent	Read
(Title) Sub.	210			add, and *è contra*
1 5	212	Bottom	Sign	11 5
2′ 56″	221	Ano.° 2	70	1′ 56″
14 22	222	d° 17	22	13 22
13 53	223	d° 17	66	14 53
17 7	ib.	d° 14	80	16 7
41 38	247	d° 19	72	41 48
$\frac{4}{11}$	267	Bottom	Signs	$\frac{4}{16}$
Sun's	272	line 2		Sun
at the End of the Title	273	3		inſert ☉ à ☽
North	282	Bottom	Title	South, and *è contra*
Againſt ♈ and ♊	290			inſert M. C.
Againſt ♋ and ♍	291			inſert M. C.
which 2	296	17		next 2
+17°.060648	339	20		−17°.60648
fourth	347	7		ſecond
Herefrom	352			Here, from
16′ 24″	400	1 h. forw.		16′ 48″

N. B. The Numbers ſee the laſt Paragraph, *p.* 110. as alſo the Re-mainders, *p.* 167. ſhould have been as in *p.* 101 and 10[illegible] but the Differences being ſo very inconſiderable, they need not be altered.